Abstract

The purpose of this study was to investigate whether long-term culturing affects the morphological and cytological characteristics of freshwater algae. Culture collections around the world maintain algae for use in a variety of biological studies. It is assumed that cultured organisms retain the normal physiological and morphological characteristics of the wild populations from which they were isolated. However, long-term culturing of organisms under artificial conditions could potentially produce changes in growth form and other characteristics that could invalidate studies using cultured algae. A culture collection of freshwater algae has been maintained in the SWOSU Department of Biological Sciences since 1993 and was used in this study.

A photographic record of each alga currently in the SWOSU culture collection was made using an Olympus BH2 light microscope coupled with a SPOT™ Idea™ 3.0 megapixel digital camera. Images were stored and measured using the SPOT 4.7 software program. Images were taken at magnifications ranging from 40 to 400X total magnification using Koehler illumination settings. Images were taken that illustrate distinguishing characteristics of each alga. Cellular dimensions (diameters and lengths) were determined from the images using the measuring function of the software. Images and measurements from the current study were compared with similar images and measurements made for the culture collection 13 years previously. Cell dimensions were analyzed statistically using the Statview® statistics package.

Does Long-Term Culturing Result in Cytological Changes in Freshwater Algae?

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Introduction

Algal cultures are used worldwide for research. This study was done to determine whether keeping cultures under artificial conditions for extended periods (> 10 years) affects the morphology of the algae. Hise and O'Neal (1997) documented the SWOSU culture in 1997 with photographic images of the algal isolates and measurements of cell dimensions. In this study we re-examined the algal isolates and made comparisons to the 1997 study.

Materials and Methods

The algal culture collection from the SWOSU Department of Biological Sciences was used in this study (Table 1). A photographic record of each alga currently in the SWOSU culture collection was made using an Olympus BH2 light microscope coupled with a SPOT™ Idea™ 3.0 megapixel digital camera (Fig. 1a). Images were stored and measured using the SPOT 4.7 software program. Images were taken at magnifications ranging from 40 to 400X total magnification using Koehler illumination settings. Images were selected that illustrate distinguishing characteristics of each alga. Cellular dimensions (diameters and lengths) were determined from the images using the measuring function of the software. Images and measurements from the current study were compared with similar images and measurements made for the culture collection 14 years previously. Eleven of the algal isolates that were present in the culture collection in in 1997 are still in the collection. Photographs from the 1997study taken with a Nikon microscope (Fig. 1b), were digitized for comparison with current images of the isolates. Cell dimensions of these eleven algal isolates were analyzed statistically using a two sample T-test (Abacus Concepts, 1992). Statistical significance was set at a P-value of 0.05.

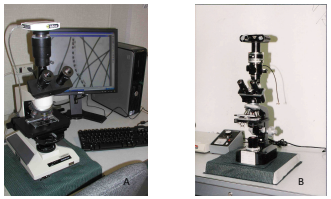

Figure 1. Microscopes used in the current study (1A) and the 1997 study (1B).

Table 1. Algal Isolates in the SWOSU Algal Culture Collection in 1997 and 2011.

Algal Isolate	Identification Number	1997	2011
Cladophora sp.	OK-15		X
Closterium acerosum	OK-07	X	X
Crowder Unknown	OK-16		X
Enteromorpha sp.	OK-13		X
Filamentous Desmid	OK-09	X	X
Hydrodictyon sp.	IN-01	X	X
Mougeotia sp.	OK-04	X	X
Oedogonium sp.	IN-05	X	X
Pithophora oedogonia	IN-04	X	X
Pithophora oedogonia	OK-10	X	X
Protoderma	OK-17		X
Spirogyra grevelliana	OK-14		X
Spirogyra rivularis	OK-06	X	X
Spirogyra sp.	IN-03	X	
Spirogyra sp.	NM-02	X	X
Spirogyra sp.	OK-01	X	X
Spirogyra sp.	OK-05	X	X
Spirogyra sp.	OK-11		X
Stigeoclonium sp.	OK-02	X	X
Vaucheria sp.	NM-01	X	
Zygnema sp.	OK-03	X	X
Number of isolates	-----	15	19

Results: Photomicroscopic Analysis

Preliminary evaluation of algal images suggest that no major changes in cytological structure occurred in the 14 years that the isolates had been in culture (Fig. 2). More detailed analysis may reveal subtle changes, such as chloroplast structure.

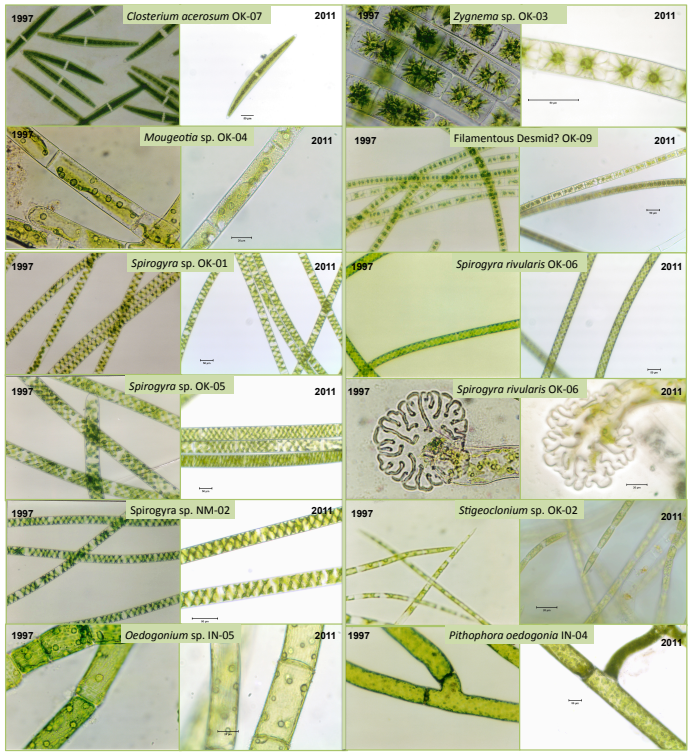

Figure 2. Comparative Images of Algal Isolates in the SWOSU Culture Collection in 1997 and 2011.

Results: Cell Dimension Analysis

Comparisons of cell diameters and cell lengths showed that most algal isolates exhibited significant changes in at least one of these cell dimensions over the 14 years between the 1997 and 2011 studies. Four isolates had decreases in cell diameter (*Mougeotia* OK-04, *Zygnema* OK-03, *Pithophora* IN-04, and the filamentous desmid OK-09) while two had increases (*Closterium acerosum* OK-07 and *Stigeoclonium* OK-02) (Fig. 3). Five isolates had similar cell diameters in the the two studies (*Spirogyra* OK-01, *Spirogyra* OK-05, *Spirogyra rivularis* OK-06, *Spirogyra* NM-02, and *Oedogonium* IN-05) (Fig. 3). Cell lengths decreased in four isolates (*Spirogyra* OK-01, *Spirogyra* OK-05, *Spirogyra rivularis* OK-06, and the filamentous desmid OK-09) and increased in two isolates (*Mougeotia* OK-04 and *Oedogonium* IN-05) (Fig. 4). Four isolates had similar cell lengths (*Spirogyra* NM-02, *Zygnema* OK-03, *Stigeoclonium* OK-02, and *Closterium acerosum* OK-07) (Fig. 4). Spirogyra NM-02 was the only isolate that showed no significant changes in either cell dimension (Figs. 3 &4).

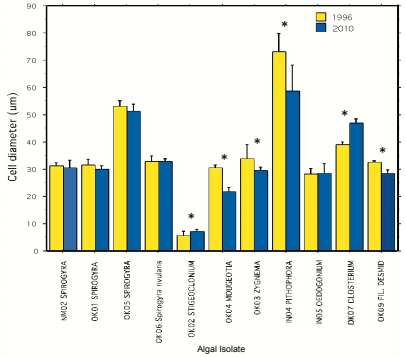

Figure 3. Comparison of mean cell diameters (µm) in 1997 and 2011. Asterisks (*) indicate statistically significant (P = 0.05) differences between the years.

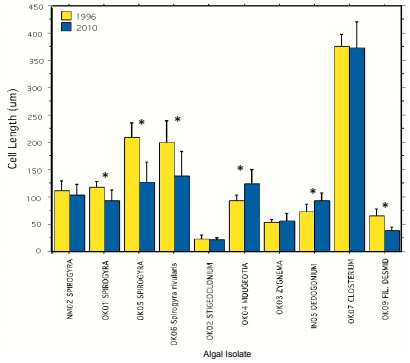

Figure 4. Comparison of mean cell lengths (µm) in 1997 and 2011. Asterisks (*) indicate statistically significant (P = 0.05) differences between the years.

Conclusions

Results of our study indicate the some cell characteristics like cell diameters and lengths can change during the time an alga is in culture. This may be significant as cell diameters are characteristics that are often used in identifying algal species. However, our images also suggest that most cell characteristics are relatively stable over long periods of culturing.

Literature Cited

Abacus Concepts. 1992. *Statview*. Abacus Concepts, Inc., CA, pp. 452.

Hise, C. and S. O'Neal 1997. Photomicroscopic Analysis of Algal Isolates. Fourth Annual Student Research/Scholarly Activity Fair, SWOSU, Weatherford, OK.

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