2. CSIRO Microalgae Research Centre – microalgae for aquaculture, biotechnology and the environment

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The CSIRO Microalgae Research Centre

The CSIRO Microalgae Research Centre is an Australian centre for excellence in microalgae research. Located at CSIRO Marine Research in Hobart, Tasmania, it comprises the Collection of Living Microalgae, the Microalgae Supply Service, and research arms of aquaculture, biotechnology and environment.

The Collection of Living Microalgae is a culture collection of over 700 strains of microalgae, representing all marine microalgal classes and some freshwater classes. It is the largest in the southern hemisphere and one of only two extensive collections in the Asia-Pacific Region. The strains are unique in that the majority are from Australian waters spanning the tropics to Antarctica, representing some of Australia's microalgal biodiversity. The collection is housed in a world-class algal culture laboratory containing constant environment rooms and cabinets. This facility supports studies on microalgal growth, physiology, biochemistry and molecular genetics. While the collection is maintained in small volume cultures (40 mL to 250 mL) there is also a range of small- to medium-scale culture technologies including chemostats, laboratory columns and photobioreactors for experimental use. The microalgae culture facility has recently been listed by the Commonwealth Department of Science, Industry and Resources as a priority national facility.

As an adjunct to the collection, the centre operates a Microalgae Supply Service, a small business that supplies cultures to industry, researchers and teaching institutions. In particular it provides high quality 'starter cultures' as food for larvae and juvenile aquaculture animals. The Supply Service has clients as far afield as Europe, the Middle East and South Africa as well as the near Asia-Pacific Region.

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[1] CSIRO Marine Research. (See details in appendix.)

Microalgae as live feeds

CSIRO has the only collection in the region holding all the 'traditional' aquaculture live food strains. The most commonly supplied strains are *Chaetoceros muelleri* CS-176, *Isochrysis* sp. (T.ISO) CS-177, *Pavlova lutheri* CS-182, *Chaetoceros calcitrans* CS-178 and *Tetraselmis suecica* CS-187. These mostly originate from the temperate northern hemisphere and are not necessarily appropriate or the best strains available for some environments, particularly in tropical Australia. In addition it is clear that some aquaculture animals (e.g. pearl oysters and abalone), as well as live feed animals (e.g. copepods) require strains that are different from the traditional strains. While these traditional strains have their use approved by AQIS, CSIRO also has concerns about extensive use of imported strains, and considers that any new strains used should preferably be endemic to Australia.

To examine all these issues, the Microalgae Research Centre has an active commitment to isolating new Australian strains and offering new strains for trial, free of charge to industry. Table 2.1 lists the commonly used Australian strains as well as new strains supplied to industry and researchers on a trial basis. Other less-commonly supplied strains such as the dinoflagellate *Heterocapsa niei* are clearly gaining prominence as alternative feeds for copepods.

Strain typing

Research in strain 'typing' being pursued by the Microalgae Research Centre in relation to its work in biotechnology is of potential significance to microalgal use in aquaculture. Our research comparing Australian and global populations from cultured strains has demonstrated great diversity within one species (Blackburn, 2000; Bolch *et al.*, 1999a, b). Strains of the one species can be very different physiologically, leading, for example, to very different growth characteristics and temperature tolerances. Knowing this can be critical to microalgal use and performance.

This diversity at the species level can be discriminated through various techniques. In our laboratory we have used several molecular techniques to demonstrate strain and population differences within one species. These methods include Randomly Amplified Polymorphic DNA using polymerase chain reaction (RAPD-PCR) as well as sequence analysis of non-conserved regions of genes; for example the intergenic spacer of the B–A sub-unit of the phycocyanin gene (Bolch *et al.,* 1996, 1999a, b). These molecular (and some chemical) methods allow 'fingerprinting' of strains. Such strain typing may become inherent in quality control in industrial applications, including aquaculture, in the future.

Table 2.1. Australian Strains Supplied to the Australian Aquaculture Industry (June 1997 – June 1999).

Species	Strain No.	Source
Commonly used strains		
Navicula jeffreyi	CS-46	NSW
Nitzschia closterium	CS-5	NSW
Rhodomonas maculata	CS-85	NSW
Skeletonema sp.	CS-252	Qld
Nannochloropsis-like	CS-246	Qld
Pavlova pinguis	CS-375	Tas
Trial strains		
Amphora sp.	CS-307	Qld
Nitzschia sp.	CS-339/2	Qld
Nitzschia sp.	CS-339/3	Qld
Nitzschia sp.	CS-373	Tas
Nitzschia cf paleacea	CS-429	Tas
Nitzschia cf paleacea	CS-430	Tas
Nitzschia cf paleacea	CS-433	Tas
Chaetoceros sp.	CS-365/2	Tas

Remote high biomass production of microalgae

The potential of remote microalgal production, compared with on-site hatchery production, depends on high biomass production of high-quality microalgal food species, as well as methods to harvest and concentrate, preserve and transport. Some of the latter topics were investigated under the FRDC Projects 93/123 and 96/342 and the CRC for Aquaculture by Knuckey and Brown. There is still inadequate research being conducted into producing a high biomass of high-quality microalgae. As part of research in our laboratory we are collaborating with the University of Florence, Italy, on high biomass production of microalgae using several different photobioreactor technologies including alveolar panel reactors (Tredici, 1999). We have trialed novel microalgae in these systems including dinoflagellates, as well as a much used Australian strain, *Skeletonema* sp. CS-252, for live feeds. We have maintained a biomass of over 1 g L^{-1} (9 x 10^6 cells per millilitre) of the latter for over 40 days. Experiments to optimise growth and production are underway.

It is perhaps pertinent to the Australian industry that for two seasons, 14 finfish hatcheries in Italy have been buying *Nannochloropsis* slurries from a remote production facility developed by Xenia S.r.l. and the Centro di Biotechnologie Fotosintetiche (U Florence). These slurries are being used for both direct feed and green-water culture. The Italian industry is interested in pursuing new alternative species for remote production. However, internationally, there have been few trials of a wide range of microalgae in photobioreactor systems. The best technology for high biomass production of live food species of microalgae for aquaculture still requires research and development.

References

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