
USE OF ASTAXANTHIN IN SHRIMP CULTURE
From: skbodapati@yahoo.com
To: shrimp@yahoogroups.com
Sent: 5 March 2006

QUESTION:
I have used Haematococcus in shrimp farm and hatchery as a source of natural astaxanthin. It is working good in both farm and hatchery. But it is expensive in India; anybody can tell me to get 3.0% astaxanthin Haematococcus at cheaper price ? If anybody wants the application part of the product I can give you.
Astaxanthin is seen as only for developing pigmentation in shrimp and salmonids. But in real, it has so many other useful things. First of all it is a very powerful antioxidant. It binds oxygen free radicals and lowers the toxicity. I have used 'Cyclop-eeze' and 'Haematococcus pluvialis' in P. monodon hatchery for larval and PL stages. But they are expensive here (normally they're not). For more information visit www.cyclop-eeze.com and for 'haemato' visit 'Parry Nutrasuitcals' website.

Satish Kumar

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COMMENTS 1:
I assume that you like to use astaxanthine to improve the reddish coloration of your shrimp after cooking. We are commercializing a natural product based on Alphalpha concentrate which is very efficient and cost effective. An experiment made by Gerard Cuzon and the AQUACOP team in Tahiti showed the real efficiency of this product to increase the carotenoids contents of the shrimp epidermal and the red coloration after cooking. I send to the Shrimp list web site a file presenting the results of this experiment:
Description: Action of the Pigmentech on the shrimp coloration
You can access this file at the URL:
<http://groups.yahoo.com/group/shrimp/files/Pigmentech%20-%20Shrimps.pdf>
http://groups.yahoo.com/group/shrimp/files/Pigmentech%20-%20Shrimps.pdf

If we talk about cost efficiency, we could use the following considerations:
The PIGMENTECH contents 1775 ppm of carotenoids for a price of 750 euros/t, which means 0.4 E/g of active principle.
The Carophyl pink contents 100 000 ppm of carotenoids for a price of 197 000 Euros/t which means 1.97 E/g of active principle.
The Paprika contents 3 000 ppm of carotenoids for a price of 3 800 Euros/t, which means 1.26 E/kg of active principle.
The extract of Paprika contents 10 000 ppm of carotenoids for a price of 7 000 Euros/t, which means de 0.7 E/g of active principle.
The Spirulina contents 4700 ppm of carotenoids for a price of 5000 to 10 000 Euros/t, which means more than 1 E/kg of active principle.
In this comparison, all the mentioned prices for all the products are ex-works prices that's means they do not consider transportation, distributor fees, etc.
This could show that our PIGMENTECH is really cost effective versus all the other sources of carotenoids which could be used to increase the coloration of the shrimp after cooking.

Hervé LUCIEN-BRUN
General Manager
AQUA TECHNA

BP 10
Les Landes de Bauche
44220 – Couëron
France
hlb@aquatechna.com
www.aquatechna.com
tel. +33 (0) 1 30 41 42 89
fax. +33 (0) 1 30 41 26 30
mobile +33 (0) 6 70 70 86 03
hlub@wanadoo.fr

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COMMENTS 2:
When I used it, I mixed astaxanthin with other components such as Vitamin C making a food namely egg's flan because the basic component was eggs. My understanding was that astaxanthin was a good source to reinforce the shrimp immunology system, and I believe it was true because after starting using it shrimp's survival increased, shrimp's gill development was faster and the external appearance looked healthier than ones fed without astaxanthin I am going to check my notes to find the procedure to prepare that food.

Robinson Bazurto
hydro1@strato.net; buhocol@hotmail.com

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COMMENTS 3
There are several studies that document the use of astaxanthin in anumber of diets associated with shrimp and fish. It is now evident that astaxanthin is an essential vitamin necessary for maturation and reproduction of various aquatic species, however it is not typically added to brood feeds. In the wild, shrimp obtain astaxanthin from the consumption of phytoplankton, zooplankton, or the animals such as krill that prey upon them. Preliminary trials demonstrate that natural astaxanthin supplementation yields substantially faster and superior results compared to paprika, as there is no lag time for biosynthetic conversion and it can be directly utilized for metabolic purposes. Natural astaxanthin is now used in some commercial diets and hatchery broodstock diets to improve larval quality, survival and allow sustained nauplii production, with noticeably better egg quality on the repeat spawns. Furthermore, a report in World Aquaculture (Volume 23(3) September 1992, p.59) documents a study by Dr. Takeshi Watanabe who demonstrated the essential role of astaxanthin in the diet of red seabream broodstock. This may represent the first indisputable proof for the requirement of carotenoids for the growth and survival of eggs and larvae.

Three other studies are:

D'Abramo L.R., N.A. Baum, C.E. Bordner and D.E. Conklin. 1983. Can J. Fish. Aquat. Sci. 40:699-704.
Latscha T. 1991. The Crustacean Nutrition Newsletter (JD Castell, KE Corpron, eds.) 7(1): 53-60.
Wyban W., G. Martinez, J. Sweeney. 1997. Adding paprika to Penaeus vannamei maturation diet improves nauplii quality. World Aquaculture. June 1997.

Todd Lorenz did a summary in 1999:
Summary:
Crustaceans cannot synthesize carotenoids, thus it must besupplied in their diet. Astaxanthin is the optimal carotenoid for the proper pigmentation of Penaeus shrimp. A nutritional deficiency of astaxanthin in the diet causes Blue Color Syndrome. Additional benefits of this essential carotenoid include roles as an antioxidant and provitamin A activity, as well as enhancing immune response,

reproduction, growth, maturation, photoprotection, and defense against hypoxic conditions common in pond cultures. Astaxanthin dramatically improves the nauplii quality and zoea survival of shrimp broodstock. One first strategy would be to supplement shrimp diets with 75-150 ppm of NatuRose astaxanthin two months prior to harvest to achieve a total body carotenoid content in excess of the critical threshold of 30-40mg/kg. A second strategy consists of supplementing 50-100 ppm astaxanthin during the entire culture period. To significantly improve nauplii quality and Zoea survival, broodstock should be supplemented with 150 ppm of astaxanthin.
Haematococcus derived astaxanthin contains 15-20 times the astaxanthin contained in krill, 4-7 times the ppm contained in Phaffia yeast, and is esterfied and organic. The synthetic forms of astaxanthin (Roche) are neither esterfied nor organic, but may contain higher amounts of astaxanthin. Also present in natural astaxanthin is the very high levels of conjugates of fatty acids which are not present in the Roche product.
We have used NatuRose from Cyanotech in 8 of our diets tailored for flatfish diets in China with notable results, especially in maturation. This was also added several years ago to our shrimp Maturation diet MadMac, along with ARA, both proven to improve the overall performance of spawns and repeat spawn quality.

Leland Lai
Aquafauna Bio-Marine, Inc.
American Life Science and Food Company LLC (A-Life)
lelandlai@aquafauna.com

DEVELOPMENT OF THE DIGESTIVE TRACT, TRYPSIN ACTIVITY AND GENE EXPRESSION IN EGGS AND LARVAE OF THE BULLSEYE PUFFER FISH SPHOEROIDES ANNULATUS
Alejandra García-Gasca, Mario A. Galaviz, Jesús N. Gutiérrez, Armando García-Ortega-2006
Aquaculture 251 (2-4): 366-376
Abstract:
Hatchery-produced Sphoeroides annulatus were studied from fertilized egg until day 32 post-hatch to examine the digestive tract development and to evaluate its digestive capacity during the larval period. Fish larvae were progressively fed microalgae, rotifers, Artemia nauplii and a formulated microdiet. Digestive tract development, trypsin activity, and trypsinogen gene expression in fish samples were analyzed by histology, histochemistry and reverse-transcription coupled to the polymerase chain reaction (RT-PCR) respectively. The intestine and liver started to develop on day 1 after hatch, followed by the pancreas. The mouth opened at day 4 after hatch, which was the start of rotifer feeding. Trypsinogen gene expression was detected very early in development, starting in the fertilized egg, showing a sharp increase in eggs at 75 h after fertilization, and then a gradual increase after hatching as the larvae developed. Trypsin activity by histochemistry was first detected at day 2 post-hatch, and maximum expression and activity were observed at days 16 to 24 after hatch, which corresponded to the period of Artemia nauplii feeding. No gastric glands were observed during the whole period of study. From day 28 onwards the fish were fed with a formulated microdiet, at this time both trypsin synthesis and activity decreased, suggesting a more important role for other enzymes in the digestion process.
(Centro de Investigación en Alimentación y Desarrollo, Unidad Mazatlán, Apdo. Postal 711, C.P. 82010, Mazatlán, Sinaloa, México; email of A. Garcia-Gasca: alegar@victoria.ciad.mx)

ARTEMIA FOR CORAL CULTURE
From: Miriam Schutter
To: artemia-l@email.sparklist.com
Sent: 22 December 2005

QUESTION:
I am a PhD student from Wageningen University, The Netherlands. I am researching the influence of abiotic factors on growth of scleractinian corals in aquarium systems. Corals feed both autotrophically (through photosynthesis by the algae in their tissue) and heterotrophically. I was wondering if anybody on this list has an idea about what strain of Artemia might be best for feeding my corals. The corals that are used in this study are Galaxea fascicularis and Stylophora pistillata. I prefer using freshly hatched Artemia that have a high nutritional value by itself. Is there any list that gives an indication of protein and/or lipid content of different strains of Artemia?

Miriam Schutter MSc.
Aquaculture & Fisheries Group, Wageningen University

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COMMENTS:
You may find some information on this site.
http://www.fao.org/DOCREP/003/W3732E/w3732e0m.htm#4.1.%20Introduction,%20biology%20and%20ecology%20of%20Artemia

As a hobbyist, since January 94, my experience tells me that most nauplii would be too large to use as a feeding regime.
Great Salt Lake brine that I use for producing live adult brine shrimp are definitely quite large. You may have some luck with the smaller San Francisco strain, but I would guess that gut loaded rotifers would be more like the size you need. For what it's worth, the Galaxia that I've had in one of my tanks for about 8 years now, has never been directly fed, and I've found that it's almost impossible to kill this coral off. Three separate years, I've had it die off so no flesh could be seen, with only white skeleton showing, and every time it comes back like nothing had happen, until the last occasion a couple of years ago, when, it came back, but for some reason doesn't send out the tentacles anymore. (at least, not in the daytime when I can see them, like it used to do). If you don't find what you are looking for, you may find something by going to hobbyist forums, like reefcentral.com, or reefs.org, where there are many scholars in all fields, but definitely many involved in all aspects of coral information.
If you scroll down on my main web site page, you can find links to these sites. http://www.angelfire.com/ab/rayjay/index.html

Ray Ford aka rayjay
rayjay@bellnet.ca

HATCHERY PRACTICES TO INCREASE SURVIVAL IN PENAEUS VANNAMEI
From: panchopons@hotmail.com
To: shrimp@yahoogroups.com
Sent: 12 January 2006

QUESTION:
I run a shrimp hatchery in Ecuador, and I can tell you a few specific things that we have added to our procedures that have helped us increase and keep a stable production.
In our 23 ton tanks:we add 700 liters of fresh water this way: 16 hours after the molt from nauplii to Zoea 1 stage we add fresh water that has been treated with 20 ppm of EDTA (trilon B) and 10ppm of Ascorbic Acid.
We stock the tanks in nauplii stage at a level of 15 tons, and increase only with 1 ton of live algae culture per day and the fresh water. You may find that it is a bit of a shock for the little Zoea, but this helps dilute, at least a little bit, any toxins or metals in the water, helps stimulate the molting process, and shocks any non fermenting-vibrio population, giving more advantage to the massive amounts that

we give of probiotics, which we give since day 0 when we fill the tanks until they leave the hatchery. We add 1 ton of fresh water every day thereafter, treated the same way (make sure there is no chlorine in the fresh water) we do this until the shrimp are swimming forward for a couple of days (aprox PL-2), then we bring salinity up only through water exchanges of 1 ton/day of sea water.
Also, if you start to see any Zoea II syndrome, feed Artemia nauplii that have been frozen for at least 24 hours (try to find a brand that has small size Artemia nauplii) to get them eating as soon as possible. The zoea II will eat it even if for some people it is early to feed Artemia. It doesn't matter if you will have a little bit of live Artemia growing later in your tank. We keep temperature at 33°C constantly and VERY GOOD AERATION is important. This helped us, and we currently have survival rates of over 80% when we transfer to our raceways in PL-6 stage.

Francisco Pons Zevallos
Guayaquil – ECUADOR
panchopons@hotmail.com

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COMMENTS 1:
I now realize how backward my own hatchery operation is.

I actually just started my hatchery in Penang, Malaysia, and I honestly do not have experience in hatching vannamei. My hatchery relies on two technicians from Thailand and from what I see, they are not educated at all and just do what they have been taught in Thailand.
Very basic stuff: feeding plankton during zoea stage, after supplemented with microencapsulated feed during zoea II, zoea III, mysis, they will start using artemia and brine shrimp flakes.
Luckily, I have been obtaining a survival rate of 40-50% each cycle, but recently my last cycle failed. Everything was ok until zoea II stage and they all started dying. Is this zoea II syndrome? My technicians tell me that the nauplii are no good for the last cycle and also I need to repaint my tanks after using them for three cycles. I have to admit the nauplii I used are very small sized and lesser quality as I obtained them locally.
To give you an idea, Malaysia has very few nauplii producers and most of them are not very good. The quality is not consistent and the majority of hatchery owners obtain nauplii from Thailand.
I also don't use chlorine to treat my water and only use UV sterilisation. My friend in Thailand tells me that it is much better this way and so far the results are ok.
I would also like to kindly ask how you keep the water temperature constant at 33°C? Heaters would really be expensive to operate and my normal tank temperature is only 29-30°C. I also don't use probiotics or at least I am not aware of it. What would you recommend and please advise if the use of probiotics stunt the growth of prawns in the ponds. This is what I have been told. My tanks are small (about 12 ton capacity) but I would like to try what you suggested in your email.

Sam Chew
aeresources@yahoo.com

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COMMENTS 2:
If I may, I would recommend you operate your hatchery according to a strict hygiene plan. Very basic stuff can work out if you respect very basic rules. After each cycle, you should allow a total disinfection of your installations (pipes, tanks,...), with a minimum dry-out period.
Although I agree with your technicians, that if NII quality isn't there, you can't expect good survival, I doubt your survival is low because of paint problems. But then again, I don't know the conditions of your facility.
It is not because you do not chlorinate your water that your water quality is not good, all the more that you have UV sterilization. I would insist on a good filtration process (up to 1 micron), as if your water

is turbid, UV sterlization will not be efficient and bacteria will develop rapidly. Which can, and probably is the reason of your losses. I recommend a minimum water exchange for the first Zoea stages as the larvae are very fragile. Moreover, be careful with salinity variations as 32ppt is favourable to Vibrio harveyi development. In order to compete with these pathogenic bacteria, you may employ probiotics, which are commonly sold by aquaculture distributors (INVE...)
Temperature is an important factor, but if you can not afford heaters, it will just be a question of a couple days more, before you reach PL stage.

Bastien Finet
bastien.finet@unima.mg

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COMMENTS 3:
Temperature variation is probably the most serious, least known, least respected, the easiest and most cost effectively controlled variable in the commercial shrimp hatchery production process. If you do much research into the non-specific immune system you can't help but recognize the importance of temperature variation on the immune system and the resulting negative impact of temperature variation on the general growth and survival metabolism mechanisms of the shrimp (other animals too, including us as well). I remember some experiments that Dr. Rolland Laramore did in the mid 90's - not sure they were ever published. In fact, I still have some of the preserved PL comparisons from that experiment on my desk to remind me of the importance of temperature variation in the hatchery environment.
He took a group of naups from one spawn and randomly divided them into experimental groups. One group was held at absolutely constant temperature – it's been a while, but I believe that was 28°C, but it may have been slightly higher - perhaps 30°C. If Rolland is watching the list he may care to straighten any kinks in my memory about his experiments out. (I also know that he did experiments examining the optimum hatchery production temps. and if I remember right - growth and survival balanced out about 30°C - a constant 30°C.). The other groups in this experiment were subjected to plus or minus 1°C variations in temperature over each day. I don't remember the survival differences, but I believe they were very significant. What I have before me are two vials of Rolland's well preserved PLs from that experiment. A group from the constant temps and a group from 1°C variation. While the PLs are from the same parents - the 1°C variation in temperature - produced 100 % differences in their weight at the time the constant temp batch of PL 8s were preserved. I also believed that there were significant developmental stage differences and consequently very significant production cost differences - especially in terms of Artemia consumption and other overhead costs. (Slower developing PLs consume more food and energy.) I also believe Dr. Laramore tracked these healthier, faster growing PLs through growout conditions and found they performed at superior levels overall in the growout. Most of us have observed that healthy hatchery animals produce better growout harvests - so this would be expected. The visual impact of the 100% wt. and size difference that just one degree variation made in these two batches of PLs is dramatic.
Don't underestimate the cost to your hatchery of your tanks not having heaters. Just as important, don't under estimate the cost of not having very accurate thermostatic controllers operating them. The best heater in this case is only as good as the thermostat on it. The ambient variation of the temperature in your hatchery building will also be a factor in controlling the tank temperatures. If it is highly variable you may also have to insulate and cover your tanks. I have watched a lot of hatchery operators go through all kinds of sophisticated and expensive contortions with cure-alls and probiotic measures to try to stabilize production, failed and wondered why, but never controlled their hatchery tank temperatures. If you don't have very stable temperatures, it is likely you will never understand the effects of all the other things that you try to use and do to tweak your production. In the final analysis - your bottom line, you will have higher hatchery production costs and weaker PLs without heaters and you will have lower production and profits in your growout. Now tell me again how affordable is temperature variation in your hatchery tanks.

Durwood M. Dugger, Pres.

BCI, Inc.
duggerdm@belsouth.net

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COMMENTS 4:
One thing that really piques my interest is temperature variation: such a simple guideline but completely overlooked. I know for a fact that the temperature in my tanks fluctuates daily and I definitely need to remedy this.
I use cement tanks and they are covered. Still the temperature fluctuates. Plus I have heaters too, but nothing to control them automatically. We put in the heater; when then water gets cold about 28°C and check constantly until water temperature reaches 30°C. After that it is switched off. Pretty backward. Not much options though and I think I have to find better heaters with accurate thermostatic controllers. Not even sure I can get them here in Malaysia but will try.

Sam Chew
aeresources@yahoo.com

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COMMENTS 5:
A cheap way to get some good control over high power heaters is to use a cheap aquarium heater from a pet shop and a power relay. The cheap aquarium heater has a thermostat control and the resistance of the heater part of the aquarium heater is much less that the resistance for the control power of a power relay. In that case, just wire the aquarium heater in series with the control power of the power relay and use the high power output of the relay to control the large electrical heater. This same setup can be used to control pumps with hot or cold water and heat exchangers for either heating or cooling and low cost per point.

Dallas E. Weaver, Ph.D.
Scientific Hatcheries
8152 Evelyn Cr.
Huntington Beach, CA 92646
714-960-4171
Cell 714-614-3925
deweaver@surfcity.net
www.ScientificHatcheries.com

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COMMENTS 6:
Great idea for small setups Dallas! Can you recommend a good brand of aquarium heater to use. My experience with aquarium heaters is that they are not all created equal and very few if any are very precise and capable of less than plus or minus 1°C range control. I have also found that as they older the contacts tend to arc. I cooked several hundred dollars worth of ornamental marine fish in my office aquarium when the contacts of the heater I was using (which had worked very well for quite some time) - apparently arced - welded together and of course was in the "on" position forever after. Apparently, I had also made the mistake of purchasing temperature intolerant fish - couldn't handle 85°C. Of course most aquarium heaters I am familiar with are housed in glass test tubes which don't seem to hold up in commercial hatchery environments. Have you ever tried to time the half life of a glass beaker in a hatchery? Just a concern, but you have a really practical idea if you can find a very precise aquarium heater in a bi-metal thermostat heater?
Also, isn't it the relay that is the expensive part? I used Bourdon tube type thermostats with stainless steel wells in the sides of my tanks. The Bourdon type thermostat wasn't terribly expensive, was fairly accurate, usually lasted about three years and were easy to replace. I bought mine out of the

Grainger Catalog at the time. I also found Grainger carried Incalloy hot water heater elements that worked fine for hatchery tank heaters. I might also mention if you are going to build your own heaters, that you might as well incorporate a small float switch that will keep the heater from coming on when the tank is low or empty. Most hatchery tank heaters die a hellious death when someone drains the tank and they have not been turned off. No matter how expensive the alloy they are housed in - it won't hold up to glowing red hot until someone smells it or sees the smoke.

Durwood M. Dugger, Pres.
BCI, Inc.
duggerdm@belsouth.net

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COMMENTS 7:
One of the interesting things about using these cheap aquarium heaters through a power relay is that the contact in the heater isn't handling any significant power and the arcing is much less. This seems to result in a longer lifetime. I had my sensors in the sump where they didn't get trashed. There are some fairly cheap ti aquarium heaters with a controller that uses a separate sensor in the water. I don't know the gut of these units, but you may be able to cut the wire to the heater and run it to a relay.

Dallas E. Weaver, Ph.D.
Scientific Hatcheries
8152 Evelyn Cr.
Huntington Beach, CA 92646
714-960-4171
Cell 714-614-3925
deweaver@surfcity.net
www.ScientificHatcheries.com

LIMESTONE FLUIDIZED BED TREATMENT OF ACID-IMPACTED WATER AT THE CRAIG BROOK NATIONAL FISH HATCHERY, MAINE, USA
Philip L. Sibrell, Barnaby J. Watten, Terry A. Haines, Benjamin W. Spaulding-2006
Aquacultural Engineering 34 (2): 61-71
Abstract:
Decades of atmospheric acid deposition have resulted in widespread lake and river acidification in the northeastern U.S. Biological effects of acidification include increased mortality of sensitive aquatic species such as the endangered Atlantic salmon (Salmo salar). The purpose of this paper is to describe the development of a limestone-based fluidized bed system for the treatment of acid-impacted waters. The treatment system was tested at the Craig Brook National Fish Hatchery in East Orland, Maine over a period of 3 years. The product water from the treatment system was diluted with hatchery water to prepare water supplies with three different levels of alkalinity for testing of fish health and survival. Based on positive results from a prototype system used in the first year of the study, a larger demonstration system was used in the second and third years with the objective of decreasing operating costs. Carbon dioxide was used to accelerate limestone dissolution, and was the major factor in system performance, as evidenced by the model result: Alk = 72.84 × P(CO2)1/2; R2 = 0.975. No significant acidic incursions were noted for the control water over the course of the study. Had these incursions occurred, survivability in the untreated water would likely have been much more severely impacted. Treated water consistently provided elevated alkalinity and pH above that of the hatchery source water.
(United States Geological Survey, Leetown Science Center, 11649 Leetown Rd., Kearneysville, WV 25430, USA; email of P. Sibrell: psibrell@usgs.gov)

HIGH RESISTANCE OF FISH PATHOGENIC VIRUSES TO UV IRRADIATION AND OZONATED SEAWATER

H. Liltved, C. Vogelsang, I. Modahl, B.H. Dannevig-2006

Aquacultural Engineering 34 (2): 72-82

Abstract:

Important fish pathogenic viruses, including infectious pancreatic necrosis virus (IPNV), Atlantic halibut nodavirus (AHNV) and infectious salmon anaemia virus (ISAV), were exposed to ultraviolet (UV) irradiation or ozonated seawater in a laboratory model system. Inactivation curves were obtained, and the occurrence of oxidants and ozonation by-products (OBP), including their removal by granular activated carbon (GAC) filtration, was studied. In ISAV, 99.9% inactivation was obtained by an UV dose of 7.7 mJ/cm2. The corresponding figures for AHNV and IPNV were 105 and 246 mJ/cm2, respectively. In ozonated seawater, total residual oxidants (TRO) were assayed by the DPD colorimetric method. The C T value (the product of TRO concentration and contact time) was calculated from the average TRO concentration (as mg Cl2/l) during the respective contact time (s). 90% reductions in virus titers were obtained by C T values of 1.4 (mg s)/l for ISAV, 1000 (mg s)/l for AHNV and 1944 (mg s)/l for IPNV. The results of this study demonstrate a wide span in UV and TRO resistance among the viruses tested. ISAV was sensitive to both methods, while high resistance in AHNV and IPNV was experienced. The TRO resistance in IPNV and AHNV contradict earlier published results and suggests reconsideration of existing ozonation practise to inactivate these viruses in seawater. Considerably higher C T values than previously reported seem to be required. These discrepancies in results between studies clearly demonstrate the need for development of a standard procedure to conduct inactivation experiments and to develop improved analytical techniques to determine individual oxidants in seawater. Of the detected carcinogenic OBPs, bromate was found in concentrations of 50 and 70 μg/l after a contact time of 20 and 80 min, respectively, at a TRO concentration of 0.9 mg/l. Bromoform was the only trihalomethane (THM) found in significant amount. The bromoform concentration of 16.4 μg/l measured after 80 min contact time was reduced to 1.6 μg/l by GAC filtration with an empty bed contact time (EBCT) of 4.2 min. TRO and bromate was reduced below the detection limit after GAC filtration. However, long-term filtration experiments were not conducted. Such experiments should be conducted to determine the adsorptive capacity of GAC for bromate- and THM-removal in ozonated seawater.

(Norwegian Institute for Water Research, Southern Branch, Televn. 3, 4879 Grimstad, Norway; email of H. Liltved: helge.liltved@niva.no)

THE EFFECT OF COLD STORAGE ON CELL VIABILITY AND COMPOSITION OF TWO BENTHIC DIATOMS

María del Pilar Sánchez-Saavedra-2006

Aquacultural Engineering 34 (2): 131-136

Abstract:

The effect of cold storage on the viability and composition of the diatoms Navicula incerta and Amphiprora paludosa var. hyalina was evaluated at weekly intervals during 4 weeks, using 8-day-old cultures grown under standards conditions, concentrated and stored at 4 °C in glass flask covered with aluminum foil. There were no differences between the cell viability measured as growth rates of aliquots of the refrigerated cultures, in comparison to that measured before cold storage. Significant differences were found only in the total and organic dry weights and in the lipid content of both species. After 3 and 4 weeks, showing that N. incerta and A. paludosa var. hyalina may be maintained under refrigeration for up to 4 weeks, without losing cell viability and nutritional quality.

(Laboratorio de Biología y Cultivo de Microalgas, Departamento de Acuicultura, Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE), Kilómetro 107 Carretera Transpeninsular Tijuana-Ensenada, Ensenada Baja California, Apartado, Postal 2732, C.P. 22860, México; email of María del Pilar Sánchez-Saavedra: psanchez@cicese.mx)

REVIEW ARTICLE:
SELECTIVE BREEDING FOR THE HYBRID STRIPED BASS (MORONE CHRYSOPS, RAFINESQUE ×M. SAXATILIS, WALBAUM) INDUSTRY: STATUS AND PERSPECTIVES
Amber F. Garber, Craig V. Sullivan-2006
Aquaculture Research 37 (4): 319 –
Abstract:
The hybrid striped bass (HSB) farming industry has considerable potential for growth into domestic retail markets, but expansion of this industry is limited by high production costs that dictate high prices for HSB. It is widely recognized within the industry that selective breeding of an improved HSB will be required to increase production efficiency and reduce market prices. A National Program of Genetic Improvement and Selective Breeding for the HSB Industry has been initiated and some progress has been made toward domestication of the parent species of the hybrid. However, uncertainty remains as to which breeding procedures will most rapidly yield sustainable genetic gains in key production traits. This paper consolidates and reviews general information on the biology of temperate basses (genus Morone) relevant to selective breeding of improved HSB. The topics covered include control of reproduction, geographic distribution of stocks and population genetic variation. This is followed by a brief review of the current application of selective breeding techniques, including those based on molecular markers. Finally, we discuss potential avenues for genetic improvement of HSB in a selective breeding program.
(Department of Zoology, North Carolina State University, Campus Box 7617, 127 David Clark Labs, Raleigh, NC 27695-7617, USA; email of A. Garber: afgarber@unity.ncsu.edu)

VIBRIOS ASSOCIATED WITH MACROBRACHIUM ROSENBERGII (DE MAN, 1879) LARVAE FROM THREE HATCHERIES ON THE INDIAN SOUTHWEST COAST
N. S. Jayaprakash, V. J. Rejish Kumar, Rosamma Philip, I. S. Bright Singh-2006
Aquaculture Research 37 (4): 351 -
Abstract :
Surveys for bacteriological analysis of larval samples to isolate the associated vibrios were carried out during 1985–1992, 2001 and 2002 in three different hatcheries located on the southwest coast of India. Vibrio isolates were examined for their species diversity, virulence based on haemolysis in prawn blood agar, lipolysis, proteolysis and chitinolysis and antibiotic sensitivity. Vibrio cholerae was the predominant species in the apparently healthy larval samples, whereas V. alginolyticus and V. vulnificus dominated during disease and morbidity. No correlation was found between the hydrolytic properties and haemolytic activity of the vibrios associated with the larvae. All isolates were resistant to erythromycin and resistance to oxytetracycline, ampicillin and streptomycin sulphate was prevalent among the larger section of the Vibrio population. This suggested that antibiotic application may not be of much use to protect the larvae from vibriosis. This is the first report on the diversity of Vibrio species associated with Macrobrachium rosenbergii larvae and their virulence characteristics based on haemolysis in prawn blood agar.
(Centre for Fish Disease Diagnosis and Management, School of Environmental Studies, Cochin University of Science and Technology, Lake Side Campus, Fine Arts Avenue, Cochin 682016, Kerala, India; email of I.S. Bright Singh: bsingh@md3.vsnl.net.in)

APPARENT DIGESTIBILITY OF SOME NUTRIENT SOURCES BY JUVENILE MUD CRAB, SCYLLA SERRATA (FORSKAL 1775)
Vu-anh Tuan, Alex Anderson, Jim Luong-van, Colin Shelley, Geoff Allan-2006
Aquaculture Research 37 (4): 359-
Abstract :
As part of preliminary work aimed at the development of a formulated diet for the mud crab, Scylla serrata, an experiment was conducted with juvenile mud crabs (95.65±2.17 g) to determine apparent digestibility coefficients (ADC) for cellulose, fish meal, shrimp meal, blood meal, soybean meal,

wheat flour and cod liver oil. Apparent digestibility coefficients for dry matter (ADCdm), energy (ADCenergy) and protein (ADCprotein) were in the ranges 70.0–95.7%, 77.4–97.1% and 57.7–97.9% respectively. Soybean meal had the highest ADCdm and wheat flour had the lowest value ($P<0.05$), while the ADCdm for fish meal, blood meal and shrimp meal were not different ($P\geq0.05$). Similarly, soybean meal had the same ADCenergy as that of fish meal, but higher than those of cod liver oil, blood meal and shrimp meal ($P<0.05$). Moreover, the ADCprotein for blood meal or shrimp meal were not significantly different from fish meal ($P\geq0.05$); nevertheless, they were lower than that of soybean meal and higher than that of wheat flour ($P<0.05$). Of significant interest was the ADCdm (78.0%) and ADCenergy (77.4%) for cellulose, which indicates that plant-based nutrient sources may well be a useful component of formulated diets for mud crabs.
(School of Primary Industries and Sciences, Charles Darwin University, Darwin, NT, Australia; email of Vu-anh Tuan: vuanhtuan2002@yahoo.com)

EFFECTS OF TEMPERATURE, STOCKING DENSITY AND DIET ON THE GROWTH AND SURVIVAL OF JUVENILE MITHRACULUS FORCEPS (A. MILNE EDWARDS, 1875) (DECAPODA: BRACHYURA: MAJIDAE)
Gil Penha-Lopes,, Andrew L. Rhyne, Junda Lin, Luis Narciso-2006
Aquaculture Research 37 (4): 398 -
Abstract:
Mithraculus forceps (A. Milne Edwards) has demonstrated a great potential for ornamental aquaculture and the present study tests the effects of temperature, stocking density and diet on the survival and growth of M. forceps juveniles. For 28 days post metamorphosis (DPM), the newly metamorphosed juveniles were reared at two temperatures (25±0.5 or 28±0.5°C), stocked at five densities (1, 5, 15, 30 or 60 crabs ring1; approximately 226, 1132, 3395, 6791 or 13 581 crabs m2 respectively) and fed with commercial pellets (CP), microalgae (Amphora spp.), live newly hatched Artemia nauplii (NHA), frozen Artemia nauplii (FNHA), or combinations of each of these diets with NHA. At the end of the temperature experiment, carapace width of the crabs cultured at 28°C was significantly larger than the crabs reared at 25°C and average intermolt period was significantly shorter. Increased stocking density had a negative effect on survivorship and growth. Survivorship at the end of the diet experiment was significantly different between the crabs not fed, fed with CP and Amphora and the crabs fed with the other diets. Between the diet treatments, the crabs fed with NHA+Amphora were significantly larger than the ones fed with NHA+FNHA, NHA, FNHA and NHA+CP, and these in turn larger than ones fed with Amphora.
(Laboratório Marítimo da Guia, IMAR, Faculdade de Ciências da Universidade de Lisboa Estrada do Guincho, 2750-642 Cascais, Portugal; email of Gil Penha-Lopes: gil@biology-research.com)

SHORT COMMUNICATION:
INFLUENCE OF DIETARY PROTEIN LEVELS ON GROWTH AND EGG QUALITY IN BROODSTOCK FEMALE BAGRID CATFISH (MYSTUS NEMURUS CUV. & VAL.)
Muchlisin Zainal Abidin, Roshada Hashim & Alexander Chong Shu Chien-2006
Aquaculture Research 37 (4): 416 -
(Aquaculture Research Group, School of Biological Sciences, University Science Malaysia, 11800 Penang, Malaysia; email of Muchlisin Zainal Abidin: icin@eudoramail.com)

SHORT COMMUNICATION:
INDUCED SPAWNING IN COMMON SOLE (SOLEA SOLEA L.)
Daniela Bertotto, Jvan Barbaro, Antonia Francescon, Jacopo Richard, Angelo Libertini, Alvise Barbaro-2006
Aquaculture Research 37 (4): 423 -

(CNR Istituto di Scienze Marine, Venezia, Italy; email of D. Bertotto: daniela.bertotto@unipd.it)

REVIEW ARTICLE:
CURRENT STATUS OF FRESHWATER PRAWN CULTURE IN VIETNAM AND THE DEVELOPMENT AND TRANSFER OF SEED PRODUCTION TECHNOLOGY
Nguyen Thanh Phuong, Tran Ngoc Hai, Tran Thi Thanh Hien, Tran Van Bui, Do Thi Thanh Huong, Vu Nam Son, Yoshinori Morooka, Yutaka Fukuda, Marcy N. Wilder-2006
Fisheries Science 72 (1): 1 – 12
Abstract:
In Vietnam, the giant freshwater prawn Macrobrachium rosenbergii is becoming an increasingly important targeted species, as its culture, especially in rice fields, is considered to have the potential to raise income among impoverished farmers. The production of M. rosenbergii based on aquaculture reached over 10 000 tons per year in 2002, having increased from about 2500 tons since the 1990s. Until recently, lack of a stable supply of seed had been an important obstacle to the further expansion and development of M. rosenbergii culture, but cumulative research on larval rearing, especially in the 1990s, has led to the development of new seed production technology based on the 'modified stagnant green water system'. Following its dissemination by the efforts of provincial authorities, hatchery operators, and farmers, the freshwater prawn seed production industry developed rapidly in the Mekong Delta with over 90 hatcheries producing 76.5 million postlarvae in 2003. This is considered to have affected the expansion of rice–prawn farming in the Mekong Delta, leading to increased aquacultural production in the region. This paper reviews the current status of freshwater prawn culture in Vietnam and background history, and presents a socioeconomic evaluation of seed production technology implementation.
(College of Aquaculture and Fisheries, Cantho University, Can Tho City, Vietnam; email of M. Wilder: marwil@jircas.affrc.go.jp)

NEW PERSPECTIVES ON AQUARIUM FISH TRADE
David Lecchini, Sandrine Polti, Yohei Nakamura, Pascal Mosconi, Makoto Tsuchiya, Georges Remoissenet, Serge Planes-2006
Fisheries Science 72 (1): 40-47
Abstract:
Since the 1990s, the international market for importing aquarium fish is suspicious of stock coming from South-East Asia. Fish catches are still executed with cyanide-based toxic products. In the present paper, the potential of the French Polynesian Islands to develop a marine aquarium fish business with a new approach is explored. Coral reef fish are captured at the larval stage with crest nets, then larvae are reared in aquaria before being put on the world ornamental fish market. This approach offers several advantages: (i) larvae are captured with a passive system placed on the reef crest (crest net) that does not destroy the environment and limits the stress on collected larvae; (ii) larvae are then put into farmed basins that allow them to be controlled sanitarily; and (iii) larvae are weaned at the farm and fed rapidly with artificial food. This method increases survival rates as it eliminates the food acclimatization problem of fish captured at adult stage (main cause of fish mortality in aquaria). Overall, reared larvae will constitute a new product in terms of species, sizes and quality of ornamental fish on the aquarium market.
(University of the Ryukyus–Laboratory of Ecology and Systematics, Nishihara, Okinawa 903-0213, Japan, email of D. Lecchini: lecchini@Univ-perp.fr)

SHORT PAPER:
EFFECT OF DIETARY COBALT SUPPLEMENTATION ON THE POPULATION GROWTH OF ROTIFER BRACHIONUS ROTUNDIFORMIS

Takao Yoshimatsu, Takahiro Higuchi, Dongming Zhang, Norma R. Fortes, Kenji Tanaka, Kenji Yoshimura-2006
Fisheries Science 72 (1): 214-216
(National Research Institute of Aquaculture, Fisheries Research Agency, Mie 516-0193, Japan; email of T. Yoshimatsu: takaoyos@fra.affrc.go.jp)

SHORT PAPER
LETHAL EFFECTS OF NONYLPHENOL ON FERTILIZED EGGS AND LARVAE OF MARBLED SOLE PLEURONECTES YOKOHAMAE
Gen Kumei, Toshihiro Horiguchi, Akihiro Goto, Tomohiko Isobe, Shigeko Serizawa, Hiroaki Shiraishi, Masatoshi Morita-2006
Fisheries Science 72 (1): 217-219
(National Institute for Environmental Studies, Tsukuba, Ibaraki 305-8506, Japan; email of Gen Kumei: kume.gen@nies.go.jp)

POST-RELEASE SURVIVAL AND RIVERINE MOVEMENTS OF GULF OF MEXICO STURGEON (ACIPENSER OXYRINCHUS DESOTOI ACIPENSERIFORMES) FOLLOWING INDUCED SPAWNING
D. C. Parkyn, D. J. Murie, D. E. Colle, J. D. Holloway-2006
Journal of Applied Ichthyology 22 (1): 1–7
Abstract:

Post-release survival and upstream movement of Gulf of Mexico sturgeon (Acipenser oxyrinchus desotoi) in the Suwannee River, Florida, were examined following induced spawning using carp pituitary extract (CPE). Six mature females (one CPE-treated and five control) and 12 mature males (five CPE-treated and seven control) were implanted with ultrasonic tags in March 2001 during their ingress into the Suwannee River. All CPE-treated sturgeon and 10 of the 12 control fish were relocated using ultrasonic telemetry during 4 months following their release, resulting in 100% survival of treated fish and 83% known survival of control fish. Two control fish (one female and one male) could not be relocated after 2 weeks post-release. CPE treatment did not result in mortality but did affect upstream movement behavior, with CPE-treated males moving upstream at a significantly slower rate than control males and females. Similarly, the maximum observed distance that the fish moved upstream differed among control fish (males and females) and treated males, with control fish moving further upstream than CPE-treated males. The rate of upstream movement for the single CPE-treated female was similar to the control females and the maximum upstream distance that this female was located was near a putative spawning area. In general, the environmental parameters of temperature, dissolved oxygen, and conductivity differed over the course of the study but did not differ between treatments and sexes. Treating sturgeon with CPE to induce spawning therefore did not cause mortality but did appear to slow the rate of upstream movement and maximum distance moved in male Gulf sturgeon
(Department of Fisheries and Aquatic Sciences, Institute of Food and Agricultural Sciences, University of Florida, 7922 NW 71st Street, Gainesville, FL 32653, USA; email of D. Parkyn: dparkyn@ufl.edu)

EFFECT OF SADDLEBACK SYNDROME AND VERTEBRAL DEFORMITY ON THE BODY SHAPE AND SIZE IN HATCHERY-REARED JUVENILE RED SPOTTED GROUPER, EPINEPHELUS AKAARA (PERCIFORMES: SERRANIDAE): A GEOMETRIC MORPHOMETRIC APPROACH
E. Setiadi, S. Tsumura, D. Kassam, K. Yamaoka-2006

Journal of Applied Ichthyology 22 (1): 49-53
Abstract:
This study examined how saddleback syndrome (SBS) and vertebral deformity affect the body shape and size of juvenile stage red spotted grouper, Epinephelus akaara, using the landmark-based geometric morphometrics method. According to the criterion of skeletal conditions, three groups, i.e. vertebral deformity, SBS, and normal groups, were identified. The results revealed significant differences in body shape among the three groups, in which the vertebral-deformed group had the deepest mid-body, the broadest anterior part, and a shortened caudal peduncle, while the SBS group showed the shallowest mid-body and the narrowest anterior part. The normal group had a body shape intermediate between the vertebral and SBS groups. A comparison of body size among the three groups revealed significant differences in centroid size, with the vertebral-deformed and SBS groups showing smallest and largest centroid size, respectively. This study illuminates that not all skeletal deformities lead to smaller body size. We suggest that rearing conditions might have caused the deformities reported herein.
(Laboratory of Aquatic Ecology, Faculty of Agriculture, Kochi University, B-200, Monobe, Nankoku, Kochi 783-8502, Japan; email of Eri Setiadi: eri14@cc.kochi-u.ac.jp)

EFFECTS OF SODIUM CHLORIDE, FORMALIN AND IODINE ON THE HATCHING SUCCESS OF COMMON CARP, CYPRINUS CARPIO, EGGS
S. Khodabandeh, B. Abtahi-2006
Journal of Applied Ichthyology 22 (1): 54-56
Abstract:
Saprolegniales are ubiquitous in natural water supplies of fish hatcheries, and often cause serious disease problems. Sodium chloride, formalin and iodine, administered twice a day as a flush at different concentrations, were tested on infected eggs of common carp, Cyprinus carpio, to evaluate their antifungal activity and effect on hatching rates. Sodium chloride at 35 000 mg L1 and formalin at 400 mg L1 were found to be most effective in controlling Saprolegnia sp., with 85.4 and 91.8% hatching rates, respectively. Iodine increased the hatching rate by 27% at 200 mg L1 ($P < 0.05$). There were infections on eggs exposed to all levels of iodine, but not on eggs treated with sodium chloride and formalin. Sodium chloride and formalin were more effective than iodine in controlling Saprolegnia. Sodium chloride is a safe, efficacious and economical treatment of Saprolegniosis and is therefore recommended for treating common carp eggs.
(Equipe Adaptation Ecophysiologique et Ontogenèse, Université Montpellier II, CP092, Place Eugène Bataillon, cc 092 F-34095 France; email of Saber Khodabandeh : saberkh@univ-montp2.fr)

COMBINED INFLUENCE OF LIGHT AND TEMPERATURE ON GROWTH RATES OF NANNOCHLOROPSIS OCEANICA: LINKING CELLULAR RESPONSES TO LARGE-SCALE BIOMASS PRODUCTION
J. M. Sandnes,T. Källqvist, D. Wenner, H R. Gislerød-2006
Journal of Applied Phycology 17 (6): 515 - 525
Abstract:
The interaction effects between irradiance and temperature on growth rates of Nannochloropsis oceanicawere determined in both laboratory cultures and large-scale tubular photobioreactors. Growth responses were investigated in 48 batch cultures subjected to crossing light/temperature gradients ranging from 34–80μmol photons m−2s−1and 14.5–35.7∘C respectively. Comparisons were made to growth responses observed in production systems (200L biofences) operated in climate-regulated greenhouses with controlled temperature and artificial light gradients. Cellular responses showed increasing specific growth rates as a function of temperature, with a peak at 25–29∘C, after which the growth became increasingly unstable. The optimum temperature for growth increased with higher light intensities up to approximately 28∘C at 80μmol photons m−2s−1. At low light intensities the

specific growth rate was less affected by temperature. The maximum daily production measured in the biofence systems increased proportionally with irradiation and reached approximately 0.7gL−1d−1at 1030µmol photons m−2s−1average daily radiation for a culture temperature of 24∘C. This corresponds to a daily yield of 140g per day in a 200L biofence system. When specific growth rates for the biofence cultures were measured at different densities and plotted against temperature, results showed a peak with the 24∘C temperature treatment. This peak became less pronounced as the density increased in the cultures. This is consistent with the laboratory results; increasing cell density in the biofence cultures resulted in less average light cell−1, which produced the same temperature dependent response as seen by reducing the external irradiance exposure for the dilute laboratory cultures.

(Norwegian University of Life Sciences (UMB), Dept. of Plant and Environmental Sciences, P.B. 5003, 1432 Ås, Oslo, Norway; email of Joanna Sandnes: joanna.sandnes@umb.no)

A PHOTOBIOREACTOR SYSTEM FOR COMPUTER CONTROLLED CULTIVATION OF MICROALGAE

Kai Marxen, Klaus Heinrich Vanselow, Sebastian Lippemeier, Ralf Hintze, Andreas Ruser, Ulf-Peter Hansen-2006

Journal of Applied Phycology 17 (6): 535 - 549

Abstract

A bioreactor system was developed for the cultivation of the microalgae Synechocystis sp. PCC6803 under controlled physiological conditions. The determination of the actual physiological state of the microalgae was provided by inline recording of chlorophyll fluorescence parameters. A feed-back loop was employed to keep the microalgae in a defined physiological state. For the construction of this feed-back loop, the temporal behaviour of the system was investigated using changes in light conditions (as caused by modulated UVB radiation) as input signal and chlorophyll fluorescence as output signal. The reproducibility of the responses was high. Kinetic analysis based on curve fitting revealed two time constants in the UVB-induced responses. The knowledge of these time constants was utilised for the development of an efficient feed-back loop which allows the cultivation of the microalgae in a defined physiological state. This new process strategy (called physiostat) was successfully tested. The performance in a culture of growing microalgae is shown.

(Forschungs – und Technologiezentrum Westküste der Universität Kiel, Hafentörn 1, 25761, Büsum, Germany; email of Kai Marxen: marxen@ftz-west.uni-kiel.de)

COMPARISON OF GROWTH AND LIPID CONTENT IN THREE BOTRYOCOCCUS BRAUNII STRAINS

Yan Li, Jian G. Qin-2006

Journal of Applied Phycology 17 (6): 551 - 556

Abstract:

The growth and lipid content of three Botryococcus braunii strains from China (CHN), United Kingdom (UK) and Japan (JAP) were compared at three temperatures (20, 25 and 30 ∘C), three irradiances (60, 100 and 300 W m−2) and four salinities (0, 0.15, 0.25, and 0.5 M NaCl) for 30 days, respectively. In the temperature trial, the UK strain and JAP strain grew faster at 25 ∘C than at other temperatures, while the CHN strain performed equally well at 20 and 25 ∘C. The JAP strain grew slowest among the three strains at all temperatures, whereas the growth rate of the CHN and UK strains was similar at all temperatures except at 20 ∘C. The UK strain contained the highest lipid content, but the CHN strain had the lowest lipid content at most temperatures. In the light trial, the highest growth rate was found in the UK strain and the lowest growth rate was observed in the JAP strain at most irradiances. The UK and JAP strains contained more lipids than the CHN strain at 60 and 100 W m−2, but the lipid content was not significantly different among the three strains at 300 W

m−2. In the salinity trial, both the CHN and UK strains grew faster than the JAP strain at all salinities, but the growth rate between the CHN and UK strains was not different. However, the CHN strain had the lowest lipid content whereas the UK strain produced the highest lipids at most salinities. Our results indicate that the CHN strain and the UK strain grow faster than the JAP strain, but the UK and JAP strains produce more lipids than the CHN strain. The UK strain should be considered as a potential B. braunii strain for the exploitation of renewable energy.
(School of Biological Sciences, Flinders University, GPO Box 2100, Adelaide, 5001, SA, Australia; email of Jian G. Qin: Jian.Qin@Flinders.edu.au)

INTEGRATED OUTDOOR CULTURE OF TWO ESTUARINE MACROALGAE AS BIOFILTERS FOR DISSOLVED NUTRIENTS FROM SPARUS AURATUS WASTE WATERS
Ignacio Hernández , M. Angeles Fernández-Engo, J. Lucas Pérez-Lloréns, Juan J. Vergara-2006
Journal of Applied Phycology 17 (6): 557 - 567
Abstract:
An integrated outdoor cultivation of two macroalgal species: Ulva rotundata (Chlorophyta) and Gracilariopsis longissima (Rhodophyta) was designed. The macroalgae were cultured in effluents from an intensive marine culture (growout phase) of gilthead seabream Sparus aurata. The biomass evolution of the algal tanks followed a logistic curve, where the approach to the maximum stocking density of seaweeds was governed by thalli self-shading, as nutrient limitation in the cultivation tank was unlikely. The maximum stocking density of the system was approximately 27.8 g U. rotundata L−1 (16.7 Kg m−2) and 11.9 g G. longissima L−1 (7.12 Kg m−2). Yield was more than 3 times higher in U. rotundata than in G. longissima. Overall, U. rotundata removed a greater percentage of phosphate (8.9%) and total dissolved inorganic nitrogen (54%) flowing into the algal tanks than G. longissima. The latter species biofiltered approximately 3.2% of phosphate and 17% of the total dissolved inorganic nitrogen input. However, mean nutrient uptake rates on wet weight basis were usually higher in G. longissima than in U. rotundata. The production of total oxidised nitrogen in the algal tanks, considered as being the nitrification rate occurring on the algal fronds by nitrifying bacteria, was less than half of the ammonium uptake by the macroalgae, suggesting that seaweeds competed efficiently for ammonia against the nitrifyers. The biofiltration during a diel cycle showed that mean phosphate biofiltration was lower than 4.5% in the two species whereas ammonium was biofiltered efficiently (up to 67%), especially in U. rotundata. The metal and heavy metal content in the algal tissue at the end of the monitoring period suggested no metal contamination of tissues so that both macroalgal species could be used in the food industry. The study reveals the value of ecological engineering techniques in reducing the dissolved nutrient content in effluents from the fish farm, with the prospect of a better management practises, based on integrated mariculture designs, being developed by the local farmers.
(Area de Ecología, Universidad de Cádiz, Facultad de Ciencias del Mar y Ambientales, 11510 Puerto Real, Cádiz, Spain; email of Ignacio Hernández: ignacio.hernandez@uca.es)

ENRICHMENT OF SLOW-GROWING MARINE MICROORGANISMS FROM MIXED CULTURES USING GEL MICRODROP (GMD) GROWTH ASSAY AND FLUORESCENCE-ACTIVATED CELL SORTING
Y. Akselband, C. Cabral, T.P. Castor, H.M. Chikarmane, P. McGrath-2006
Journal of Experimental Marine Biology and Ecology 329 (2): 196-205
Abstract:
Encapsulation of cells in agarose gel microdrops (GMDs) combined with fluorescence-activated cell sorting (FACS) has been used previously to analyze and recover specific mammalian, bacterial, and yeast cell populations. Recently, we have developed a method to enrich mixed bacterial populations for slow-growing microorganisms using the GMD Growth Assay combined with fluorochrome staining and flow cytometry. Here, we demonstrate the feasibility of using this experimental approach to detect clonogenic growth of individual bacteria within GMDs in less than 3 h and to separate

subpopulations based on differential growth rates. We show that after sorting, organisms remain viable and can be propagated in culture for further analysis.
(One Cell Systems, 100 Inman Street, Cambridge, MA 02139, United States; email of Y. Akselband: yaks@onecell.com)

EFFECTS OF CONSTANT AND VARYING TEMPERATURES ON THE DEVELOPMENT OF BLUE SWIMMER CRAB (PORTUNUS PELAGICUS) LARVAE: LABORATORY OBSERVATIONS AND FIELD PREDICTIONS FOR TEMPERATE COASTAL WATERS
Simon R. Bryars, Jon N. Havenhand-2006
Journal of Experimental Marine Biology and Ecology 329 (2): 218-229
Abstract:
Temperature is widely held to be a critical factor for the development of marine invertebrate larvae. We investigated three specific aspects of this relationship for the blue swimmer crab, Portunus pelagicus, in a temperate gulf: (1) the effects of different but temporally constant temperatures on the survival and developmental period of larvae reared in the laboratory, (2) the effects of varying temperatures on the survival and developmental period of larvae reared in the laboratory, and (3) prediction of larval developmental periods under seasonal temperature changes found in the field. Temperature had a marked effect on larval survival. At constant temperatures of 22.5 and 25 °C larval survival was far greater than at lower temperatures down to 17 °C, and developmental period of the larval period was inversely related to (constant) temperature. However, larvae in temperate coastal waters will usually be exposed to seasonally varying, rather than constant, temperatures. To account for this, a larval developmental period model was created and then verified in the laboratory by rearing larvae under varying temperatures. Results of this work demonstrated that developmental periods were markedly different under constant versus varying temperature regimes. Using different temperature simulations for a temperate gulf (Gulf St Vincent, South Australia), the developmental period model predicted that in years of 'average' seasonal temperature changes, total larval developmental period could range from 26 to 45 days depending on the day of hatching. In such cases, peak postlarval settlement was predicted to occur between mid January and mid March. Results from this study also predict that larval survival (and thus postlarval settlement) will be maximised in years with abnormally warm summers. Whilst the developmental period model was used to make predictions of developmental period for P. pelagicus in a temperate gulf, it could readily be adapted to predict developmental periods in other coastal environments.
(School of Biological Sciences, Flinders University of South Australia, GPO Box 2100, Adelaide, SA 5001, Australia; email of S. Bryars: bryars.simon@saugov.sa.gov.au)

LIPID CLASS DYNAMICS DURING LARVAL ONTOGENY OF SEA SCALLOPS, PLACOPECTEN MAGELLANICUS, IN RELATION TO METAMORPHIC SUCCESS AND RESPONSE TO ANTIBIOTICS
Fabrice Pernet, V. Monica Bricelj, Simon Cartier-2006
Journal of Experimental Marine Biology and Ecology 329 (2): 265-280
Abstract:
This study examines ontogenetic changes in lipid class composition in relation to survival and growth of five batches of sea scallops, Placopecten magellanicus, from egg to dissoconch stages. It also investigates the effects of antibiotic addition during metamorphosis to determine whether transient treatment during this critical period is effective in increasing metamorphic success. The top-performing larvae (growth rate: 4.7-5.0 μm day− 1, dissoconch survival: 32–57%) were characterized by a pronounced increase in absolute (ng larva− 1) and relative concentrations (wt.% of total lipid) of triacylglycerol (TAG) during the pre-metamorphic period, followed by utilization during metamorphosis (0.5–1.4 μg day− 1 larva− 1). In contrast, the low-performing scallops (growth rate: 3.6–4.5 μm day− 1, dissoconch survival < 1%) exhibited a constant, low level of TAG. These results strongly suggest that the accumulation of TAG during the pre-metamorphic period is a good predictor

of scallop performance as measured by survival to dissoconch stage. Antibiotic treatment enhanced absolute and relative TAG concentrations in pre-metamorphic scallops and resulted in higher post-metamorphic survival and TAG concentration than in non-treated controls. However, the proportion of dissoconch to live larvae at the end of the experiment was significantly lower with antibiotic treatment (8% vs. 20% in controls), thus resulting in comparable yields of dissoconch larvae 8% irrespective of treatment. A possible negative effect of antibiotic treatment on bacterial induction of settlement and metamorphosis of sea scallop larvae is suggested.
(National Research Council, Institute for Marine Biosciences, 1411 Oxford Street, Halifax, NS, Canada B3H 3Z1; email of F. Pernet: fpernet@umcs.ca)

TROPHIC MODIFICATION OF ESSENTIAL FATTY ACIDS BY HETEROTROPHIC PROTISTS AND ITS EFFECTS ON THE FATTY ACID COMPOSITION OF THE COPEPOD ACARTIA TONSA

Adriana J. Veloza, Fu-Lin E. Chu, Kam W. Tang-2006
Marine Biology 148 (4): 779-788

Abstract :
To test whether heterotrophic protists modify precursors of long chain n−3 polyunsaturated fatty acids (LCn−3PUFAs) present in the algae they eat, two algae with different fatty acid contents (Rhodomonas salina and Dunaliella tertiolecta) were fed to the heterotrophic protists Oxyrrhis marina Dujardin and Gyrodinium dominans Hulbert. These experiments were conducted in August 2004. Both predators and prey were analyzed for fatty acid composition. To further test the effects of trophic upgrading, the calanoid copepod Acartia tonsa Dana was fed R. salina, D. tertiolecta, or O. marina that had been growing on D. tertiolecta (OM-DT) in March 2005. Our results show that trophic upgrading was species-specific. The presence of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in the heterotrophic protists despite the lack of these fatty acids in the algal prey suggests that protists have the ability to elongate and desaturate 18:3 (n−3), a precursor of LCn−3PUFAs, to EPA and/or DHA. A lower content of these fatty acids was detected in protists that were fed good-quality algae. Feeding experiments with A. tonsa showed that copepods fed D. tertiolecta had a significantly lower content of EPA and DHA than those fed OM-DT. The concentration of EPA was low on both diets, while DHA content was highest in A. tonsa fed R. salina and OM-DT. These results suggest that O. marina was able to trophically upgrade the nutritional quality of the poor-quality alga, and efficiently supplied DHA to the next trophic level. The low amount of EPA in A. tonsa suggests EPA may be catabolized by the copepod.
(Virginia Institute of Marine Science, 1208 Greate Road, Gloucester Point, VA 23062, USA; email of Fu-Lin E. Chu: chu@vims.edu)
