Feed the Future Innovation Lab for Collaborative Research on Aquaculture and Fisheries (AquaFish)

Aquaculture Collaborative Research
Support Program Technical Sessions at
Aquaculture America 2007
San Antonio, Texas, USA
26 February – 2 March 2007
Session Organizer: Dr. Hillary S. Egna

Proceedings

Assembled by Briana Goodwin
Edited by Jenna Borberg

AquaFish Management Office
Oregon State University
Strand Agriculture Hall
Corvallis, Oregon USA

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AQUAFISH INNOVATION LAB

Program activities are funded in part by the United States Agency for International Development (USAID) under CA/LWA No. EPP-A-00-06-00012-00 and by participating US and Host Country institutions.

The mission of the AquaFish Innovation Lab is to enrich livelihoods and promote health by cultivating international multidisciplinary partnerships that advance science, research, education, and outreach in aquatic resources. Bringing together resources from Host Country institutions and US universities, the AquaFish Innovation Lab emphasizes sustainable solutions in aquaculture and fisheries for improving health, building wealth, conserving natural environments for future generations, and strengthening poorer countries' ability to self-govern.

Acknowledgements
The AquaFish Management Entity acknowledges the contributions of researchers and the support provided by participating US and Host Country institutions, including the associated collaborators involved in this work. The editors acknowledge the contributions of Ford Evans, Kat Goetting, Stephanie Ichien, and Amanda Hyman.

This publication may be cited as:
AquaFish Innovation Lab. November 2017. Aquaculture Collaborative Research Support Program Technical Sessions at Aquaculture America 2007. AquaFish Innovation Lab, Oregon State University. Corvallis, Oregon, USA.

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Aquaculture America 2007
San Antonio, Texas, USA
26 February – 2 March 2007
Sessions organized by Dr. Hillary Egna

The 2007 World Aquaculture Society's Aquaculture America was held in San Antonio, Texas February 26 to March 2. On March 2, Dr. Egna moderated a well-attended CRSP session featuring 10 presentations on CRSP global successes in production, health and safety, marketing, and capacity building.

Aquaculture CRSP Session Agenda
Thursday, March 1, 2007, 08:30 - 12:30

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Remedios Bolivar

08:45 **Markets for Honduran tilapia**
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09:00 **Susceptibility of the White Spot Syndrome Virus (WSSV) to ultraviolet (UV) light in a recirculation system type raceway**
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09:15 **Intensive larviculture of South American catfishes *Pseudoplatystoma fasciatum* and *Pseudoplatystoma coruscans***
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Aquaculture CRSP Session
Abstracts and Presentations

Assessment on the use of tilapia as biomanipulators in shrimp farming in Negros Occidental, Philippines

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The use of tilapia as biomanipulators in shrimp farming, or also known as green water technology, has played an important role in the current efforts in the Philippines to control luminous bacteria disease caused by Vibrio harveyi. At present, green water technology is most extensively used by shrimp farmers in the island of Negros, in the central part of the Philippines. While the contribution of tilapia as a biomanipulator is highlighted in the literature, the mechanism of action is not well-understood. This study was conducted mainly to assess the contribution of tilapia in green water system. The data were gathered came from shrimp ponds practicing basically two production systems: a) green water system (probiotics + tilapia) and b) closed/semi-closed system (probiotics alone). There was no difference between luminous vibrio count ($p<0.05$) in both systems and that water quality was found to be similar ($p<0.05$). Because the green water system utilizes a bigger reservoir to raise the tilapia biomass, the net shrimp production was lower. In terms of direct cost of production, however, the green water system was around 10-15% lower than the closed/semi-closed system due to the significantly less aeration required. Also, in green water system, there was a more stable plankton environment during the early months of culture, which promoted better survival of shrimps. Various pathways are presented in the control of luminous bacterial growth in shrimp ponds by green water technology, namely: a) feeding on organic wastes and conversion to feces; b) selective foraging to increase the dominance of beneficial phytoplankton; c) bioturbation; and d) release in the water column of antimicrobials from mucus. The combined actions of these pathways and not just any single effect are believed to be responsible for the overall effectiveness of the green water technology.

Markets for Honduran tilapia

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The Honduran markets for tilapia present three components, the export market to the United States of America, the domestic market, and the less important but growing market in the neighbouring Central American countries.

The export of fresh tilapia to North America became important beginning around 1996 when a large commercial fish farm began exporting fresh tilapia fillets from northern Honduras. Several years later a second farm began export of tilapia fillets. Honduran exports of fresh fillets surpassed 6,572 MT with a value of USD 41,315,394 for 2005 at an average FOB price of USD 6.28/Kg. It is expected that for 2006 these amounts will be surpassed and Honduras will be the second most important exporter of fresh fillet to North America after Ecuador.

The export of fillets has provoked an important change in the perception of tilapia among Hondurans and Central Americans in general. Traditionally tilapia has been perceived as a fish used primarily to assist rural families suffering from extreme poverty and poor nutrition. Since the commencing of exports, the fish is now very much appreciated and appears in almost every fish display case in public markets and supermarkets across the country. It is also very prominent on restaurant menus.

Over the past ten years there has been a proliferation of restaurants offering tilapia in Honduras. These range from white tablecloth restaurants, locally operated US fast-food franchises and simple roadside eateries. Some of the roadside eateries maintain live fish in tanks to assure a fresh product for their clientele. Prices for a Kg of live fish range between USD 1.73 to 2.30 and for clean fish (in the round) from USD 2.30 to 2.90. Locally, fresh or frozen filet average price is USD 7.00/Kg. Prepared tilapia in restaurants is sold in Honduras at prices ranging up to USD 12.22, a value that surpasses the price for the finest marine finfish fillets on the same menu.

Local demand for tilapia has stimulated greater production among small and medium-scale fish farmers in Honduras. The increased local demand has resulted from the publicity given to the export of fillets from Honduras and the availability of the product in the local markets and supermarkets.

Several Honduran fish farmers are exporting their fish (fingerlings for stocking ponds and processed fish for consumption) to neighbouring countries in Central America. El Salvador and Guatemala are two growing markets for tilapia where prices are superior of those in Honduran markets.

Susceptibility of the White Spot Syndrome Virus (WSSV) to ultraviolet (UV) light in a recirculation system type raceway

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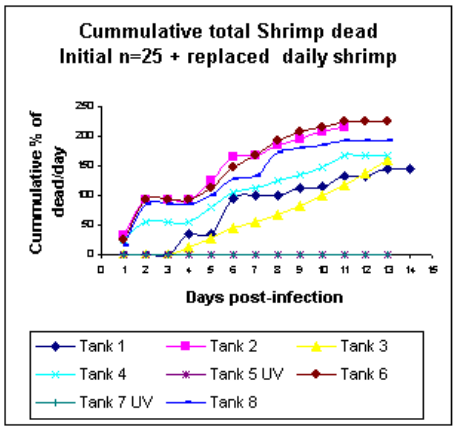
Bacterial and viral diseases are common problems in aquaculture. The use of flow-through systems frequently represents a risk of contamination resulting in diseases that impact the industry. Nowadays, the use of disinfection methods in water is a common practice to avoid the introduction of pathogens and to reduce pathogens in contaminated systems. White spot syndrome virus (WSSV) is a shrimp disease responsible for substantial economic losses in many countries. Several studies on the inactivation of WSSV by UV light have assessed the efficacy of their units by either exposing infected tissue or virus stock solution directly to a static UV light irradiation for different periods of time. None of these studies had been tested on running water. A viral challenge is necessary to determine the virucidal effectiveness of the system at 4 L/min flow rate. A challenge model was developed to observe the inactivation of the WSSV. The present study was conducted to determine if the specific pathogen free (SPF) indicator shrimp might take WSSV from infected water effluent after treatment with UV light.

SPF *Litopenaeus vannamei*, 2.5-gr avg. wt., were acclimated to 25 ppt. artificial seawater. Once acclimated, they were distributed in four pairs of tanks (25/tank). Each pair of tanks had one infected tank by injection and one non-infected. Water effluent from the infected tank was pumped and to the non-infected, and returned to the infected tank by gravity. Two pairs of tanks had UV light (G15T8) to irradiate the water effluent before pass to the non-infected tank. The other two pairs of tanks (control group) had no UV light irradiation to the water effluent. Moribund and dead shrimp were collected and frozen to determine if infected with WSSV by using PCR.

After 5 weeks, the tanks with water infected with WSSV and treated with UV did not have any mortality. The tanks exposed to water infected and not treated with UV resulted in infected and dead shrimp. Dead shrimp were counted and replaced.

This study demonstrated that it is possible to eliminate the viral infectivity effects of the WSSV by treating the water with UV. Further studies on flow rate and UV exposure time will be done to determine the UV lethal doses required to inactivate WSSV.



Intensive larviculture of South American catfishes *Pseudoplatystoma fasciatum* and *Pseudoplatystoma coruscans*

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Interest in commercial farming of the bared surubim *Pseudoplatystoma fasciatum* and the spotted surubim *P. coruscans* has increased considerably in Brazil during the past few years due to the quality of their meat and high market value. However, larviculture of both species is difficult since they exhibit cannibalistic behavior. This characteristic and the lack of an adequate feeding management during larviculture result in reduced survival rates during this phase. In 2000 we started a new line of investigation at the Aquaculture Center focusing on the development of rearing techniques of these surubins, based on the knowledge of their morpho-physiological characteristics during the ontogeny.

Histological studies on the development of the digestive system of the bared surubim have shown that the zymogene granules are visible in the larval pancreas at the 2nd day post hatching (DPH) and the differentiation of the segments of the digestive tube started at the 3rd DPH. At 10DAH the first gastric glands were observed. The mucus cells in the esophagus were of two types, one PAS positive and another AB negative. In the intestine, mucus cells were PAS positive and AB moderately positive. Parallel investigation focusing on the activity of digestive enzymes (trypsin, chymotrypsin, pepsin-like, amylase and lipase, from 1 to 53 DPH) showed that the pancreatic protease activities were already detectable at the time of endogenous feeding (1-2 DPH). The trypsin and chymotrypsin activities increased after the beginning of exogenous feeding (3rd DPH). Pepsin-like activity increased at the 10th DPH, corresponding with the appearance of the first gastric glands in the stomach. We conclude that bared surubim larvae possess well developed digestive enzyme apparatus and weaning them to artificial diets is an achievable goal at this stage (10 DPH).

The morphological development of the eye, chemo-, mechano- and electroreceptors was studied in the spotted surubim. The olfactory organ and the taste-buds (oral and extra-oral receptors) develop precociously and quickly during the early larval stage and indicate that chemoreception is of primary importance for the detection and capture of the food. The vision is probably of secondary importance and the elevated number of ampullary electroreceptors spread in the epidermal surface of the cephalic region points to the importance of the electroreception for the larval behavior. Additionally, the mechanoreception (lateral line and the free neuromasts) develops in surubimlater metamorphosis. Based on combined results of feeding and larval growth under light and dark condition, we recommend rearing of surubim larvae in darkness throughout metamorphosis.

Several experiments were carried out in Brazil and US aiming at the development of feeding techniques during larviculture and feed training of the surubins, using live and dry diets. The results suggest the need of artemia nauplii during the first 10 days; after this period, the weaning to formulated food is feasible. Cannibalistic behavior is high during the transition.

Aquaculture waste management in China

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This review aims to identify the major cause, potential compromise and management strategies of aquaculture waste in current China. Aquaculture activities are well known to be the major contributor to the increasing level of organic waste and toxic compounds in the aquaculture industry. The main contaminants of the wastewater effluent are suspended solids, ammonium, organic nitrogen and phosphorus. Aquaculture wastewater discharges may cause many environmental problems to the receiving waters. Nutrient removal is essential for aquaculture waste treatment to protect receiving waters and for potential reuse of the treated water. Therefore, it is apparent that appropriate waste treatment processes are needed for sustaining aquaculture development. A number of physical, chemical, and biological methods used in waste treatment applied in aquaculture systems have been presented in this review. The principles, advantages and disadvantages of the commonly used waste treatment systems are examined. Among which biological treatment has been considered the most feasible approach for enabling water reuse. Besides, new approaches are introduced as references for the potential development of waste treatment system in China.

Tilapia farming: a comparison of enterprise profitability among Ghanaian farmers

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Efficient management of a tilapia farm can make the difference between profits and losses even in years with unfavorable prices and costs. Farm management involves more than just taking care of the biological processes involved; it includes paying close attention to economic and financial measures of the farm business also. A comparison is made of economic and financial indicators of 10 fish farmers each in the Brong-Ahafo and Ashanti regions of Ghana, analyzing the performance of the tilapia farm businesses.

A survey was conducted to assess the profitability of tilapia farming in two growing regions - Ashanti & Brong-Ahafo in Ghana. Sampling was non-random aided by government directory and based on ability of respondent to provide information. A total of 10 farmers each from Ashanti and Brong-Ahafo regions (20 farmers) were surveyed. Performance indicators examined included Operating Profit, Net Income, Net Profit, Return to Land and Capital, Break-even Price, Break-even Production, and Rate of return to total investment.

Results suggested that fish farming in the Ashanti region was more profitable than fish farming in the Brong-Ahafo region. Profitability in the Brong-Ahafo region applied to farmers producing fingerlings for sale. Break-even production averaged 913kg in the Brong-Ahafo region compared to 877kg for the Ashanti region. Ashanti region performed better in measures of profitability. Farmer who constructed their own ponds had positive net profit. Ashanti region break-even price of $1/kg was lower than break-even price of Brong-Ahafo operations. Measures of profitability were generally better for farmers who provided supplementary feed.

Table1: Average Performance

Performance Indicators	Brong Ahafo	Ashanti	Overall
Operating Profit ($/ha)	1,062.60	3,501.79	2,386.76
Net Income ($/ha)	666.13	2,882.21	1,803.73
Net Profit ($/ha)	-1,590.72	-608.83	-1,171.88
Return to Capital ($/ha)	392.45	2,665.75	1,560.84
Return to Land & Capital ($/ha)	617.06	2,810.62	1,739.23
Production (kg/ha)	1,364.18	2,105.50	1,757.38
Pay-back Period	10.40	5.09	7.41
Break-even Price ($/kg)	1.25	0.99	1.10
Break-even Production (kg)	903.84	876.80	894.56
Rate of Return to Capital (%)	0.70	20.34	11.39
Rate of Return to Total Investment (%)	1.79	19.46	11.40

Use of dietary phytochemicals as a new method to sex-reverse Nile tilapia – aqueous plant extracts versus synthetic steroids

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Many studies have focused on the use of chemicals produced by plants (phytochemicals) as sex steroid endocrine regulators. Such studies anticipate that phytochemicals will act as endocrine modulators by changing endogenous hormone profiles. These effects could be related to their aromatase inhibitory capacity among other unidentified mechanisms. If such activity is precisely expressed by these chemicals, they could provide a novel (alternative to synthetic inhibitors) mode of action to induce changes in the phenotypic process of sex differentiation in fish gonads. Natural plant chemicals with expected safer utilization and handling issues, and possibly lower toxicity for both fish and the surrounding environment, are a very attractive alternative.

We conducted a feeding trial on first feeding all-female Nile tilapia (>80% female). Fish were randomly distributed into glass aquaria in a recirculation system at a temperature 262 C, at the density of 60 fish per aquarium with three replicates per treatment. Experimental casein-gelatin based diets were prepared as follows: control (CON), 0.006% 17(MT), 1% spironolactone (SPIRO), along with the aqueous extracts of 0.1% (H100) and 0.5% (H500) of *Hibiscus macranthus* and mate (*Ilex sp*.), (M100 and M500 respectively), and 0.5% of maca (*Lepidium meyenii*) (MACA). In case of all plants, aqueous extracts were added to the diets on the dry matter basis. To obtain such aqueous extracts, 20 g of dry plant material was suspended in 1.5 l of distilled water for 12 hours, filtered using paper filters and resulting suspended solutions were freeze-dried to obtain dry powder extracts.

Fish were fed for 40 d, with periodical weight gain estimations at 14 and 28 d to readjust feeding ratio from 20 to 8%. Fish performance was evaluated in terms of the final individual body weight, survival (%), specific growth rate (SGR, %/day) and feed conversion ratio (FCR). The final sex was determined by microscopic analysis of gonad squashes at the end of the experiment.
Results indicated that the sex ratio of genetically all-female tilapia is not affected by the inclusion of the tested plant extracts; however the MT and SPIRO groups exhibited significant changes in sex ratio, 100% and 75% males, respectively (Fig 1). SPIRO affected negatively the survival of experimental fish (49.5compared to the other treatments (94.3No significant differences were observed in the final individual body weight (0.71g), SGR (10.6%/day) or FCR (0.94among dietary groups.

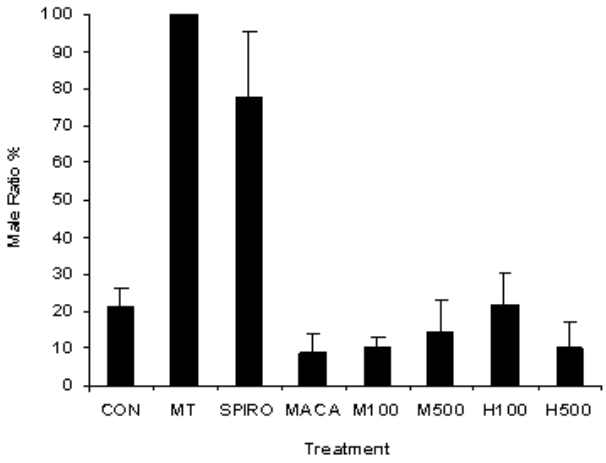

Fig 1. Final sex ratio per dietary treatment (Mean±SD, n=3; 79-90 fish per diet were sexed).

Stocking ratios of tilapia *Oreochromis niloticus* and African catfish *Clarias gariepinus* and their effects on yield and profitability in earthen ponds

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Mixed-sex tilapia culture typically leads to overbreeding, resulting in small-sized (stunted) fish that are of low value to producers. When stocked with a predator such as the African catfish (*Clarias gariepinus*), larger fish and higher yields are usually obtained. However, in Kenya Nile tilapia:African catfish polyculture is not commonly practiced, largely because fish farmers lack information on appropriate stocking ratios, economic implications, and the anticipated outputs at harvest. This study was conducted to test the yields and profitability of *Oreochromis niloticus* and *Clarias gariepinus* stocked at different ratios in organically fertilized earthen ponds.

A 182-day trial of different stocking ratios for mixed-sex tilapia/catfish polyculture was conducted in 100m2 earthen ponds at Moi University, Eldoret, Kenya. Tilapia:catfish ratios of 2:1, 6:1, and 19:1 (wet weight basis) were tested alongside a tilapia-only control.

Mean daily growth rates, final weights, and yields of market-size Nile tilapia were significantly higher ($P<0.05$) in the 2:1 polyculture treatment than in all other treatments (Table 1). No significant differences ($P>0.05$) were seen among daily growth rates or final weights of African catfish among the polyculture treatments (Table 2), but gross and net catfish yields varied significantly with stocking ratios, with the highest yields observed in the 2:1 stocking ratio. Survival among treatments was not significantly different for either tilapia or catfish (Tables 1, 2).

The 2:1 stocking ratio was the most cost effective and the least profitable was tilapia stocked alone (Table 3), suggesting that Kenyan farmers stocking mixed-sexed tilapia can significantly improve their yields and income by stocking African catfish with tilapia at a ratio of 2:1 by weight.

Assessment of riparian buffers for protecting streams from small and large scale agricultural developments in Kenya

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This research is part of a USAID project to protect Fisheries in Lake Victoria, the Worlds second largest source of fresh water from Agricultural Pollution. Sedimentation, nutrient runoff, and biomass burning have induced rapid eutrophication of Lake Victoria, leading to decreased productivity in the lakes fishery industry. The project site is the Nzoia river basin (Moiben watershed) where soil erosion degrades the land and drains millions of fertile soil into Lake Victoria. Documented studies show that river Nzoia contributes the most sediment loading to Lake Victoria from the Kenyan catchment mainly because of its high discharge of 118m3/s (48% of the total). The total suspended solids contributed by Nzoia are in the magnitude of 2,504,367 tonnes/year. The project evaluates the impact of streamside cultivation on water quality using GoogleEarthPro as a remote sensing tool for monitoring and extracting basin characteristics, the Universal Soil Loss Equation (USLE) for erosion prediction, and Environment Protection Agency (EPA) - Sediment Delivery Ratio (SDR) for predicting sediment yield. Typical maps are shown in Figure 1. Both the USLE and the EPA-SDR models are developed using TK Solver program. Several study sites have been analyzed with varying riparian width (0 - 300m) and a riparian cover percent of 5% - 75% of the respective catchment areas. Results for a typical analyses are shown below. Also a predominantly row crop agriculture (Sugar cane production) zone was considered. Typical results of the investigation are shown in Table 1 for one of several sites investigated. The preliminary project findings indicate that Agricultural pollution appears not to be a significant problem now, but could become so with time in the cane production region; a socially workable strategy for implementing riparian zones may be to increase the nominal 30 m thickness but allow local use of the riparian zones. Industry and municipal waste pose a far greater danger to the fishery than the Agricultural Pollution; and Google Earth Pro appears useful for initial surveys.

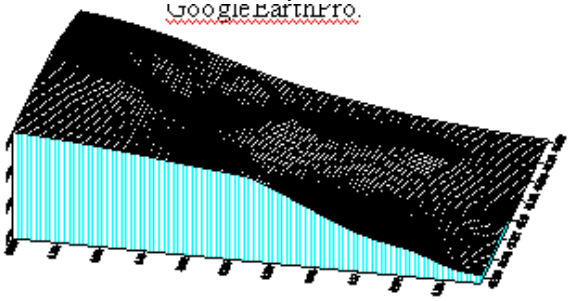

Figure 1. Three dimensional elevation map as determined using GoogleEarthPro.

Table 1. Selected analyses results from the Moores Dam site along the Nzoia River, Kenya

Selected Property	Plot 1	Plot 2	Plot 3
Eroded Soil (Mg/ha-yr)	97.2	320.1	171.4
Plot Area (ha)	4.39	3.64	4
Total Eroded Soil (Mg/yr)	426.7	1165.2	685.6
Sediment Delivery Index (SDR)	0.02	0.01	0.01
Stream Sediment Yield (Mg/yr)	6.6	7.7	6.8

Coliform bacteria concentration in two coastal lagoons of the Mexican Pacific Ocean with oyster growing

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In a coastal lagoon of the Mexican Pacific Ocean (Camichwhere there is a Crassostrea cortesiencis oyster growing and other (Santa Marde la Reforma) where the Crassostrea gigas oyster growing is planned, coliform bacteria concentrations were analyzed, in order to know if they classify as shellfish growing Approved Areas according with: NOM-031-SSA1-1993 (Official Mexican Norm).

For each of the three samplings carried out on 2006 (February, June and September) thirty water samples were collected in The Camichin lagoon and thirty-seven in The Santa Marde la Reforma lagoon. Water samples were analyzed for bacteria using dilution test series of three glass tubes, recommended by: NOM-031-SSA1-1993 (Official Mexican Norm).

In The Camichin lagoon, median and geometric mean of the bacteria concentration exceeded in two sample dates the 70 NMP/100ml (for total coliform bacteria) and 17 NMP/100ml (for fecal coliform bacteria) criteria of the official norm and concentrations lower than standard but so close to the limit were observed in February only. An inverse relation was observed between the bacterian concentration and water salinity which changed from 29 to 4.

For none of the three samples realized in the Santa Marde la Reforma lagoon, coliform bacteria concentrations exceded the approved area criteria for the oyster growing. For this lagoon, water salinity varied from 37 to 29.

The results have been showed to the lagoons users to create an Integrated Management Program which allows a suitable administration of basin residual waters and improve the growing zone quality.