Utilization of Microbial Floc in Aquaculture Systems: A Review

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Introduction

- Present aquaculture production systems often utilizes a low, or zero water exchange regime
- Advantages:
  - Provides increased biosecurity to the systems
  - Allow move away from coastal areas
  - Decreases pumping and feed costs

Introduction con't

- Over time, systems experience a buildup of metabolic wastes within the culture system
- Different floc systems have been employed to facilitate waste recycling

Floc:

- Particulate material suspended by aeration or circulation
- Typically composed of aggregations of autotrophs and heterotrophs and non-living matter:
  - bacteria
  - phytoplankton
  - fungi
  - ciliates
  - nematodes
  - detritus

Autotrophic systems:

- Photoautotrophs - phytoplankton
- Chemoautotrophic bacteria

- Utilize light or chemical energy sources to synthesize needs. Carries out nitrification of ammonium and nitrite.
- Systems are often unstable, difficult to manage, cycles of blooms and crashes.

Composition of the Floc

- Crude Protein, range: 35-50%
  - Slightly deficient in arginine, lysine and methionine
- Crude Lipid, range: 0.6 – 12%
- High Ash, range 21-32%

Supplemental nutrition for shrimp/fish

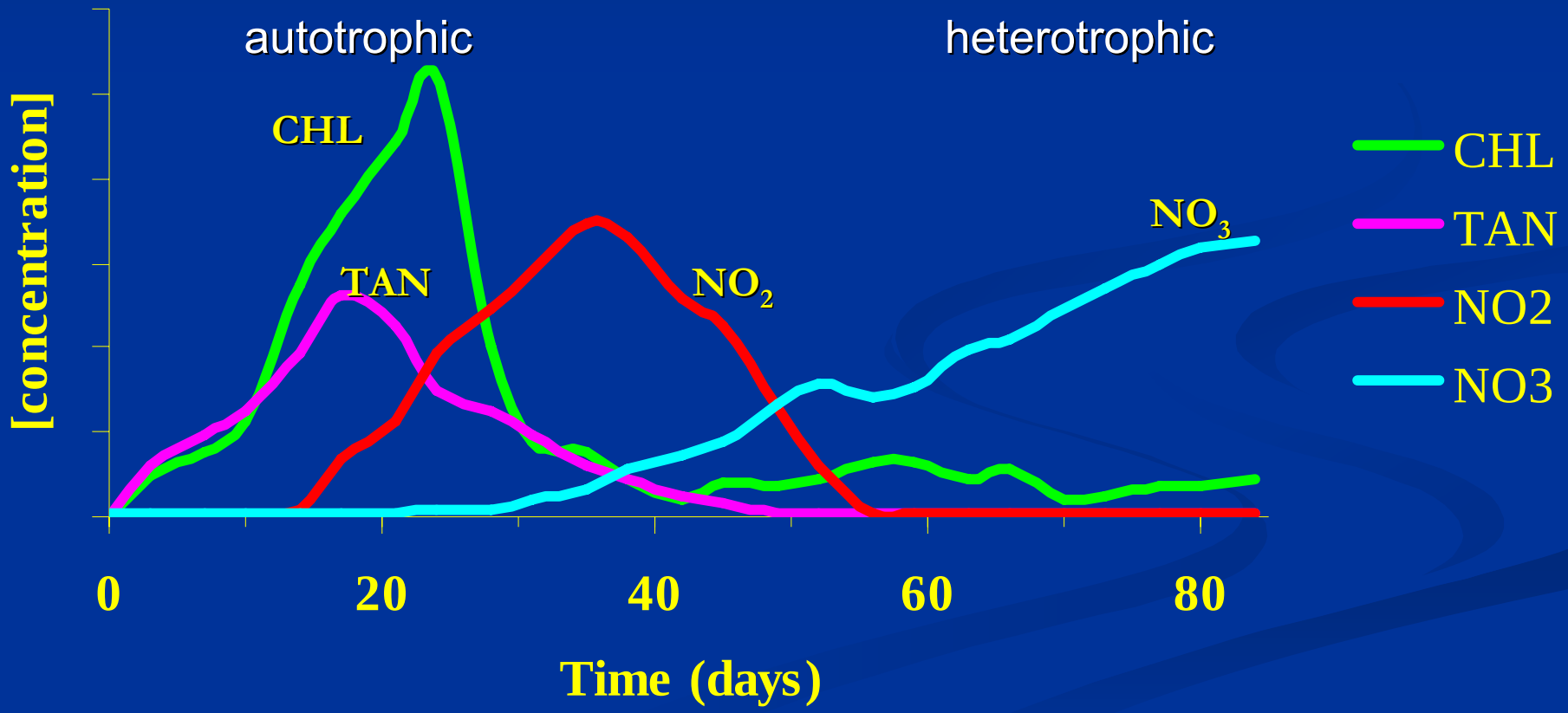
- Studies have shown enhanced growth performance
- Stable Isotope studies have proven incorporation of nitrogen into shrimp and fish.
  - (Anderson 1987, Epp 2002, Burford 2004)

Heterotrophic bacterial systems:

- Requires carbon source
  - molasses
  - sugars
  - flours
- High C:N (20:1, Avnimelech 1999) will compete with phytoplankton to directly assimilate ammonium to synthesize bacterial protein – utilized by detrital feeders
- Striving toward sustainable production through stable system and water reuse.

Diagrammatic N cycle in zero-exchange shrimp system

$NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$



Floc Studies

	species	Den-sity	Floc	Additions	Purpose		
CRUSTACEANS					Nutri-tion	WQ	Biose curity
Stahl 1979	*M. rosenbergii*	ex	A		■		
Anderson et al 1987	*L. vannamei*	ex	A		■		
Hunter et al 1987	*L. vannamei*	sem	A				
Moss & Pruder 1995	*L. vannamei*	med.	A		■		
Moriarty 1997	*general*		A, H		■	■	■
Focken et al 1998	*P. monodon*	ex	A		■		
Avnimelech 1999	*P. monodon*	in	H	sugar, cassava	■	■	
McIntosh et al 2000	*L. vannamei*	in	A	probiotic		■	
Martinez-Cordova et al 2002	*L. stylirostris*	sem	A,H	N, P fertilizers	■	■	

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	Species	Den-sity	Floc	Additions	Purpose		
CRUSTCEANS	con't				Nutri-tion	WQ	Biose-curity
Moss 2002	L. vannamei	in	A, H		■	■	
Tacon et al 2002	L. vannamei	in	A, H		■	■	
Yusoff et al 2002	P. monodon	semi	A, H	N, Si, probiotic	■	■	
Burford et al 2003	L. vannamei	in	A,H				
Abraham 2004	P. monodon	in	A, H		■	■	■
Burford et al 2004	L. vannamei	in	A ,H	molasses	■		
Liu & Han 2004	M. Rosenbergii L. vannamei	in	H			■	
Hari et al 2006	P. monodon	ex	H	tapioca flour	■	■	
Schneider et al 2006	L. vannamei	in	H	proposed- fish waste	■	■	

Floc Studies

	Species	Den-sity	Floc	Additions	Purpose		
FISH	con't				Nutri-tion	WQ	Biose-curity
Schroeder et al 1990	carp, tilapia	ex	A	manure	■		
Avnimelech et al 1994	tilapia	in	H	wheat flour, sorgum	■	■	
Avnimelech 1999	tilapia	in	H	sugar, cassava meal	■	■	
Queiroz & Boyd 1998	channel catfish	semi	A	probiotic		■	
Sefling	tilapia	in				■	
Schneider 2005	sea bass, tilapia	in	A, H	fish wastes		■	
Metaxa et al 2006	sea bass	in	macroalgae			■	
Matos et al 2006	sea bass, turbot	in	macroalgae			■	

Future Studies

- Probiotics
  - To manage system by adding commercial bacterial additives to manage system rather managing existing community
- Formulated feeds designed specifically for the system


Mahalo & Aloha