Tracing Nitrogen in Food Webs using Compound Specific Isotope Ratio Mass Spectrometry

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Biomarker Signature for;

⇨ Sterols	Faecal contamination, algae, higher plants, high-organic anaerobic environments
⇨ Bile Acid	Human and animal faceal matter
⇨ Ketones	Algal and paleoclimatic markers
⇨ Long-chain diols	Algal markers (e.g. Eustigmatophytes)
⇨ Fatty Acids	Algal and bacterial markers
⇨ Polar Lipids	Algal and bacterial biomass, community structure and nutritional status (from cell membrane)
⇨ Hydrocarbons	Oil spills / reserves, algal groups (diatoms, blue green algae)
⇨ C & N Isotopes	Biogeochemical studies of primary productivity and foodwebs

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Fitzroy River – macrotidal, subtropical estuary

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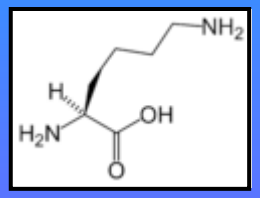
New Markers for New Applications

Amino Acids



Tracing the flow of nitrogen through biogeochemical systems

How much re-working is carried out by heterotrophic bacteria?

How important is N_2 fixation in this system? Cyanobacteria?

Measuring changes in trophic structures in pelagic ecosystems

★ Distinguishing between nutrient and trophic dynamics in ecosystems

Evaluating fishery impacts on ecosystems

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New Markers for New Applications

Amino Acids

Essential versus non-essential amino acids describe carbon flow through Biochemical systems; e.g synthesis of specific carbon skeletons

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Amino Acids

Trophic amino acids	Source amino acids
Valine	Alanine
Leucine	Glycine
Isoleucine	Serine
Aspartate	Proline
Glutamate	Threonine
Methionine	Tyrosine
Phenylalanine	Aspartate
Alanine	Serine
Proline	Lysine
Trytophan	Glutamate
*Histidine	Phenylalanine
*Arginine	Tyrosine
	Cysteine
	Glutamine
	Asparagine

Essential amino acids

Non-Essential amino acids

The difference in $\delta^{15}N$ values of these two groups reflect the degree of transanimation experienced during biosynthesis.

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The bulk $\delta^{15}N$ values in white muscle tissue of eastern pacific tuna ranged from 10 to 15‰ depending on latitude.

The amino acid $\delta^{15}N$ values in white muscle tissue of eastern pacific tuna range from;

Source amino acids 2.2 to 7.5‰ depending on latitude

Trophic amino acids 27.5 to 30.8 ‰ depending on latitude

From Popp *et. al*., 2008

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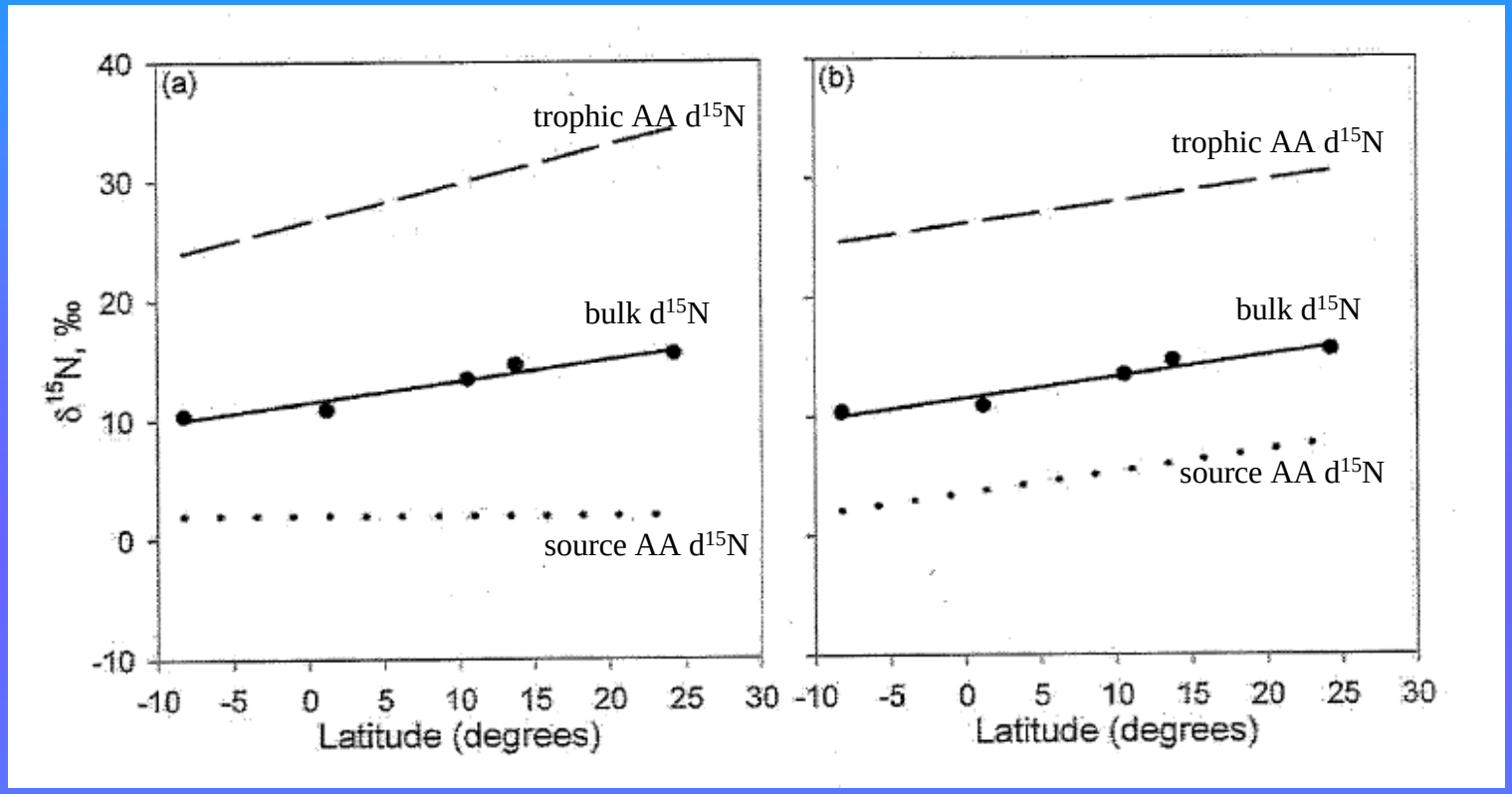

a) No change in $\delta^{15}N$ at the base of the food chain, but a trophic shift with latitude

b) No change in $\delta^{15}N$ trophic level, but a shift in the base of the food chain with latitude

From Popp *et. al.*, 2008

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Utilizing effluents in the production of shrimp / prawns

Benefits of the right microbial community structure to shrimp culture

- Enhanced animal growth
- Improved animal product quality such as colour
- Improved water quality through reduction of ammonia and nitrite
- Enhanced animal health through stimulation of immune system

Ju *et. al.* 2008

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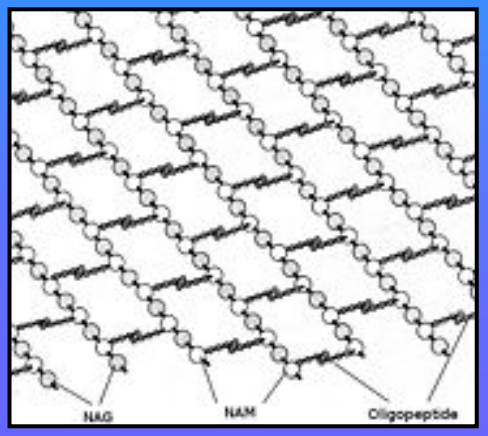
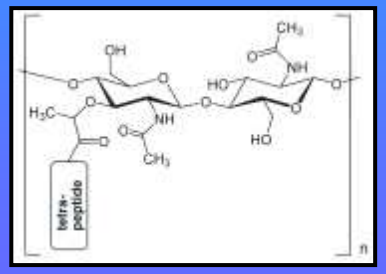
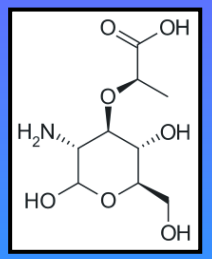


Peptidoglycan (or murein) forms
The membrane of gram-positive
And gram-negative bacteria



Peptidoglycan consists of alternating
ether linked N-acetylglucosamine
and N-acetylmuramic acid monmers

Muramic Acid



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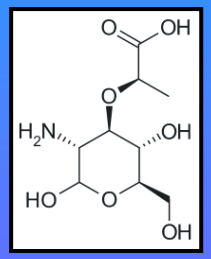
Muramic Acid



Measures how much bacteria is present in complex samples

Also contains nitrogen thus will compliment biogeochemical studies as both a source biomarker and an isotopic biomarker

In conjunction with pigment analyses can determine the community structure of floc cultures.

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Table 3 Profiles of phytoplankton community structure (%) of shrimp floc samples collected from outdoor raceways and cylindrical culture tanks

	Phytoplankton community composition (%)			
Algal class	**Floc-A**	**Floc-B**	**Floc-C**	**Floc-D**
Diatoms	4.3	8.2	84.4	81.7
Chlorophytes	82.3	75.4	5.5	9.8
Cyanobacteria	5.9	0.6	0.1	0.1
Dinoflagellates	2.6	6.9	7.3	7.5
Cryptophytes	5.0	8.9	2.7	0.9

Table 4 Algae and bacteria biomass ($g\,kg^{-1}$) and their ratios (dried sample basis) of floc materials collected from outdoor shrimp raceways and tanks

Biomass/floc type	**Floc-A**	**Floc-B**	**Floc-C**	**Floc-D**
Algae biomass	244.1	43.7	252.3	239.9
Bacteria biomass	12.8	78.3	25.6	34.2
Total	256.9	122.0	277.9	274.1
Algae:Bacteria (ratio)	19.1:1	0.5:1	9.9:1	7.0:1

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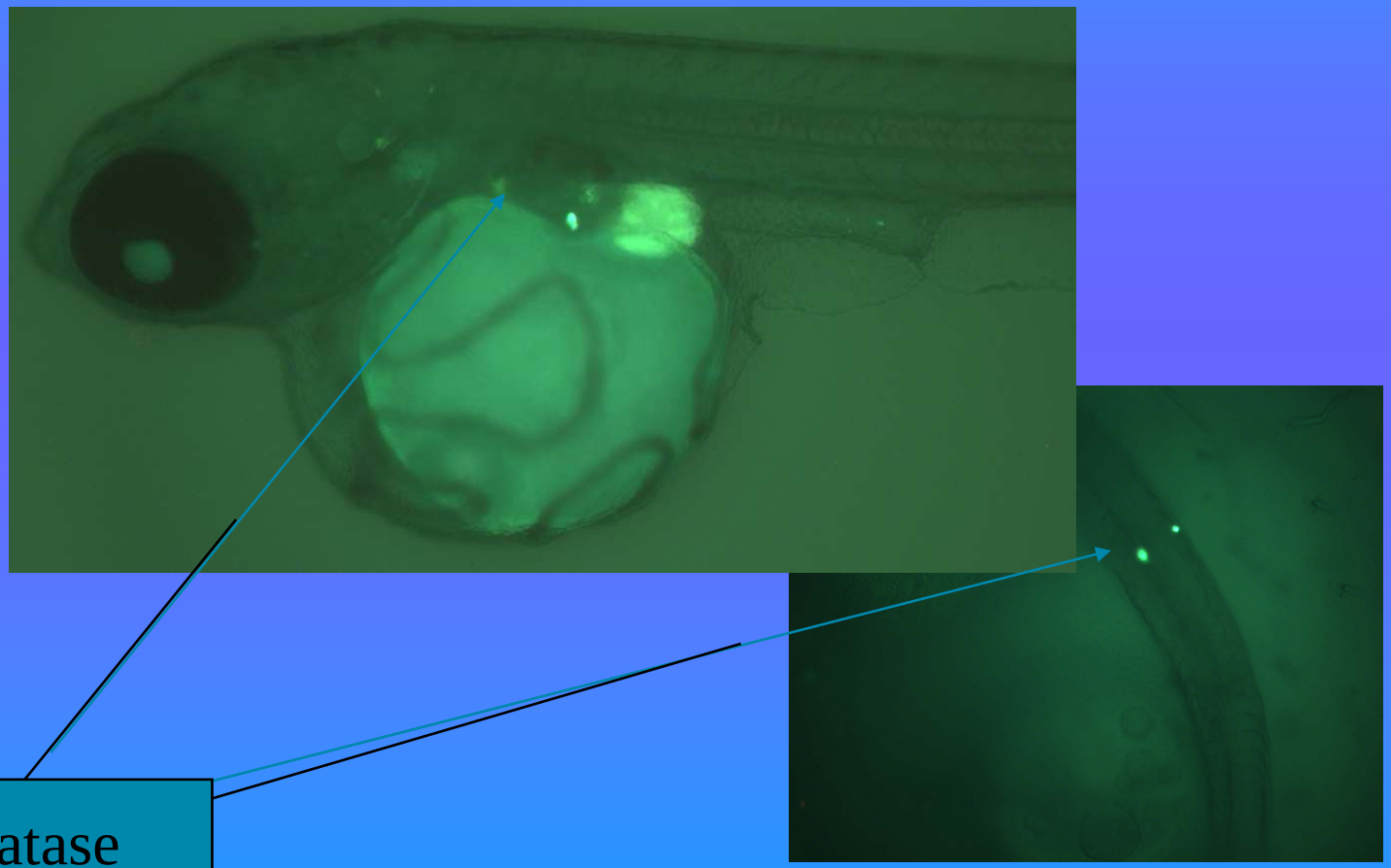
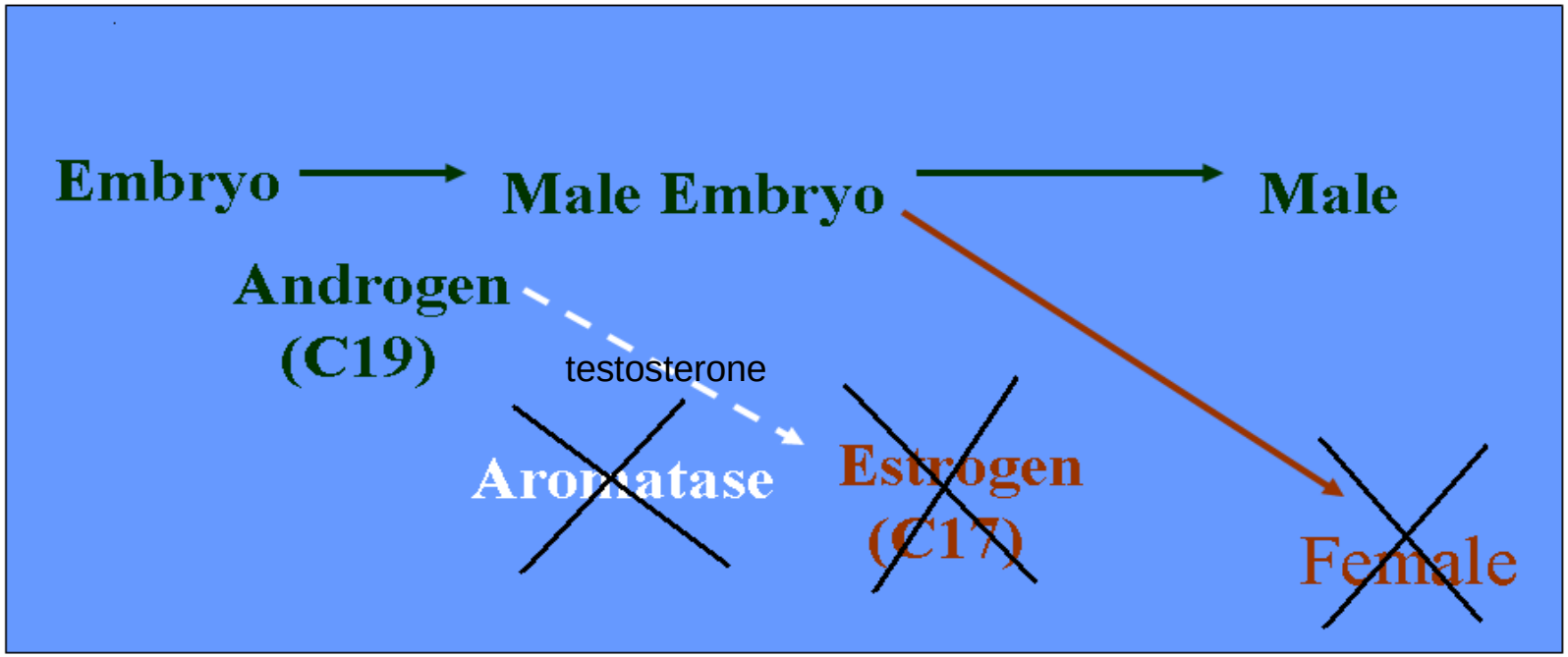
From Ju *et. al.*, 2008

Larval fish with genetic construct to switch off aromatase



Aromatase blocker ON

Fish Sexual Development



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Estradiol

Measurement of phenotypic expression of genetically modified organisms

- Eradication of pest species e.g carp
- Manipulated aquaculture species; e.g. breeding, triploid

Environmental issues

- Imposex; e.g. tri-butyl tin exposure
- Endocrine disruption studies

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