AMINO ACIDS AS SIGNAL MOLECULES AFFECTING FEEDING BY MICROZOOPLANKTON

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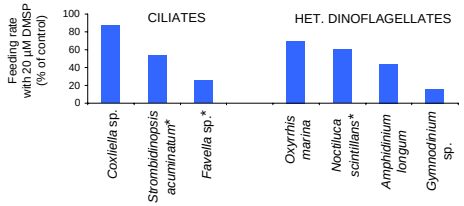
OVERVIEW

•In previous research, we have shown that dissolved DMSP reduces feeding in many protist grazers:



*Data courtesy of K. Fredrickson

•We wished to understand WHY and HOW protists respond to this chemical signal

•Feeding responses to algal chemical signals could ARISE FROM and AFFECT protist grazer interactions with algal prey (BOTTOM-UP) and/or predators (TOP-DOWN)

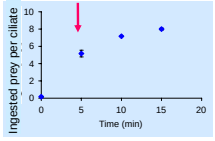
EXPERIMENTAL APPROACH

•Protist grazers were starved before feeding trials (except feeding state experiment)

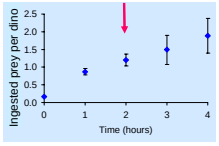
•Dissolved chemicals (20 µM unless indicated) were added to protists in quadruplicate; after 10-15 min, algal prey were added (T = 15˚C)

•Based on preliminary experiments, a single sampling time-point was used to estimate ingestion rates (arrows):

Favella sp. fed *Heterocapsa triquetra*

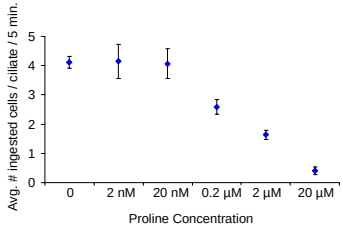


Gymnodinium dominans fed *Rhodomonas* sp.



•An early experiment with FUNCTIONAL ANALOGUES of DMSP (algal anti-oxidants, algal osmolytes) showed that PROLINE, an amino acid, strongly inhibited feeding.

AMINO ACID EFFECT IS CONCENTRATION-DEPENDENT



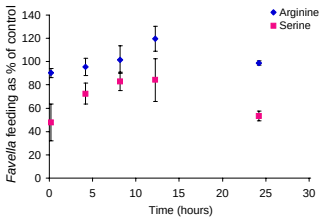
RESULTS

•*Favella* feeding rate decreased at >20 nM proline

•Total dissolved free amino acid concentrations in seawater typically range from 2 to 20 nM

•*Favella* may be adapted to respond to amino acid 'signals': pulses 10-100x stronger than persistent background levels

FEEDING REDUCTIONS WEAKEN OVER TIME



RESULTS

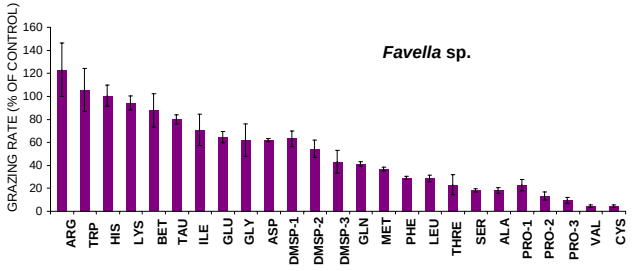
•Feeding inhibition by 20 µM serine was weakened but still detectable 12 hr after chemical addition

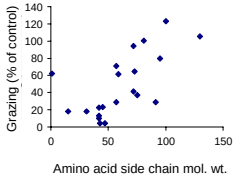
•*Favella* growth rates were similar in all treatments:

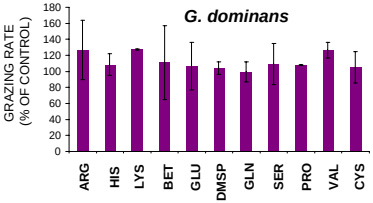
CONTROL:	0.009 d^{-1}
ARGININE:	0.007 d^{-1}
SERINE:	0.009 d^{-1}

indicating added chemicals were not toxic (ciliates were starved except when subsampled for 5-min feeding assays)

AMINO ACID EFFECTS ON PROTIST GRAZING RATE







RESULTS

•Ciliate *Favella* decreased feeding in response to numerous amino acids at 20 µM

•Feeding inhibition was roughly proportional to amino acid side chain length, suggesting a common cell-surface receptor that optimally responds to molecules with small side chains

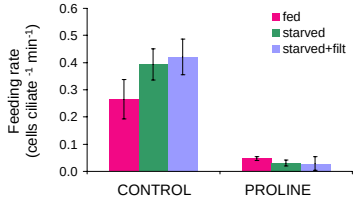
•Heterotrophic dinoflagellate *G. dominans* showed no response or slight stimulation of feeding in response to 20 µM amino acids

NO DEPENDENCE ON FEEDING STATE

•Ciliate *Favella* was preconditioned (22 hr) with three treatments:

FED:	*H. triquetra* cells at 620 cells ml^{-1}
STARVED:	no food
STARVED/FILTRATE:	no food, filtrate from *H. triquetra* culture equivalent to 620 cells ml^{-1}

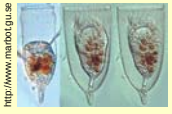
•Rate of uptake of fluorescently labeled *H. triquetra* (at 15% of total algal concn.) was used to measure feeding rate in all treatments



RESULTS

•Control feeding rates (over 10 min) were higher in starved treatments

• Feeding rates with added proline did not depend on feeding state



BOTTOM LINE:

•Ciliate *Favella* showed large, long-lasting feeding reductions in the presence of small side-chain amino acids

•By affecting feeding and swimming behavior (see Wolfe poster TS24 79), common algal-derived compounds may act as potent deterrent signals with substantial ecological effects

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