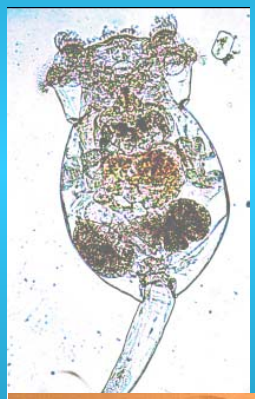
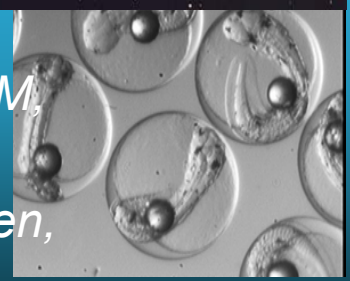
The importance of arachidonic acid, as a modulator of stress resistance through the HPI axis, in gilthead seabream larvae (*Sparus aurata*)





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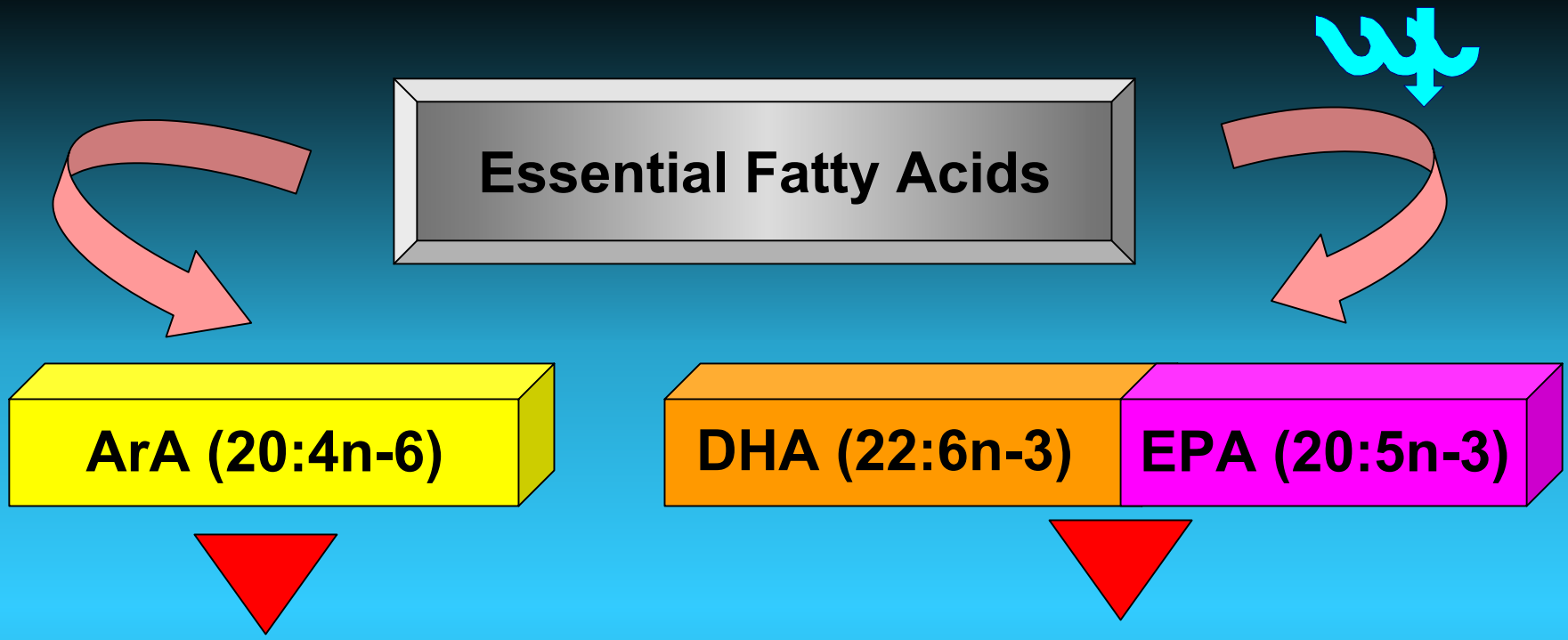


- not essential in membranes
- precursor for prostaglandins
- cellular regulation

- essential function in cellular membranes
- required for good growth
- retinal function and improved vision

Selected fatty acids of the enrichment phospholipid and biomeal preparations from Martek Biosciences and the commercial product AlgaMac 2000

Components	DHA-PL + Algal meal	ARA-PL + Algal meal	AlgaMac 2000
Selected Fatty acids (% of TFA)			
Docosahexaenoic acid (DHA)	35.9	2.4	24
Arachidonic Acid (ArA)	0.0	52.5	0
Eicosapentaenoic acid (EPA)	0	0.2	0.6
Docosapentaenoic acid (DPA)	0	0	12.9

The values (mg g^{-1} ± SEM) of selected fatty acids and fatty acid ratios of the rotifers fed the enrichment treatments

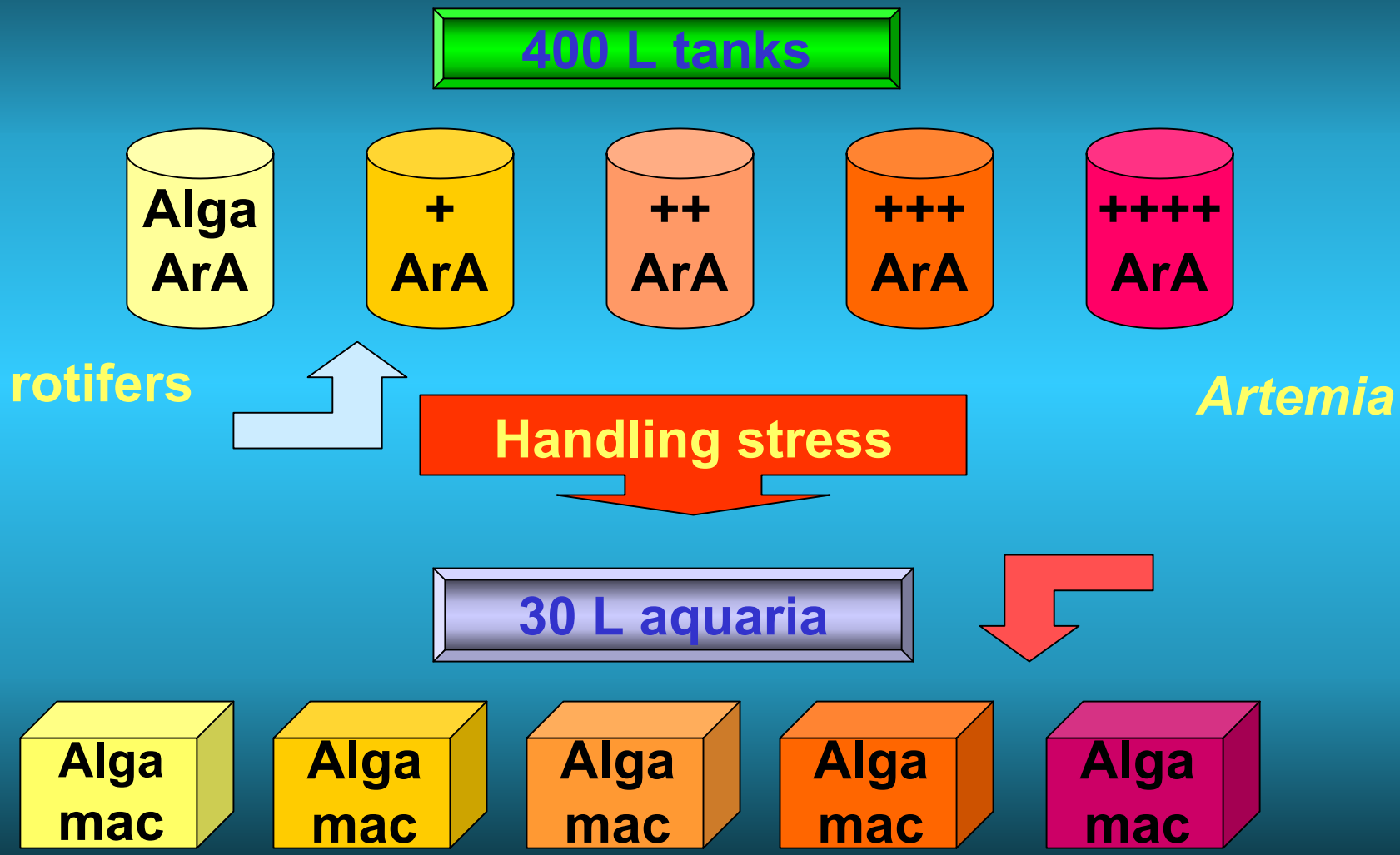
	AlgaMac	0% ArA	12.5% ArA	25% ArA	50% ArA
22:6n-3 (DHA)	7.7 ± 2.0	6.5 ± 1.4	5.7 ± 0.1	6.2 ± 2.2	4.2 ± 0.2
20:5n-3 (EPA)	3.4 ± 0.8	2.3 ± 0.4	3.0 ± 1.0	2.2 ± 0.8	2.5 ± 1.0
22:5n-6 (DPA)	2.2 ± 0.6	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0
20:4n-6 (ArA)	1.5 ± 0.3	0.8 ± 0.3	1.7 ± 0.2	3.0 ± 1.0	5.3 ± 0.6
DHA/EPA	2.3 ± 0.6	3.0 ± 0.6	2.4 ± 0.7	2.8 ± 0.1	2.3 ± 0.7
DHA/ArA	5.2 ± 1.4	9.1 ± 1.6	3.4 ± 0.4	2.1 ± 0.1	0.8 ± 0.1
EPA/ArA	2.2 ± 0.0	3.4 ± 0.9	1.7 ± 0.3	0.7 ± 0.0	0.5 ± 0.2

Transfer from tanks to aquaria characterized handling stress

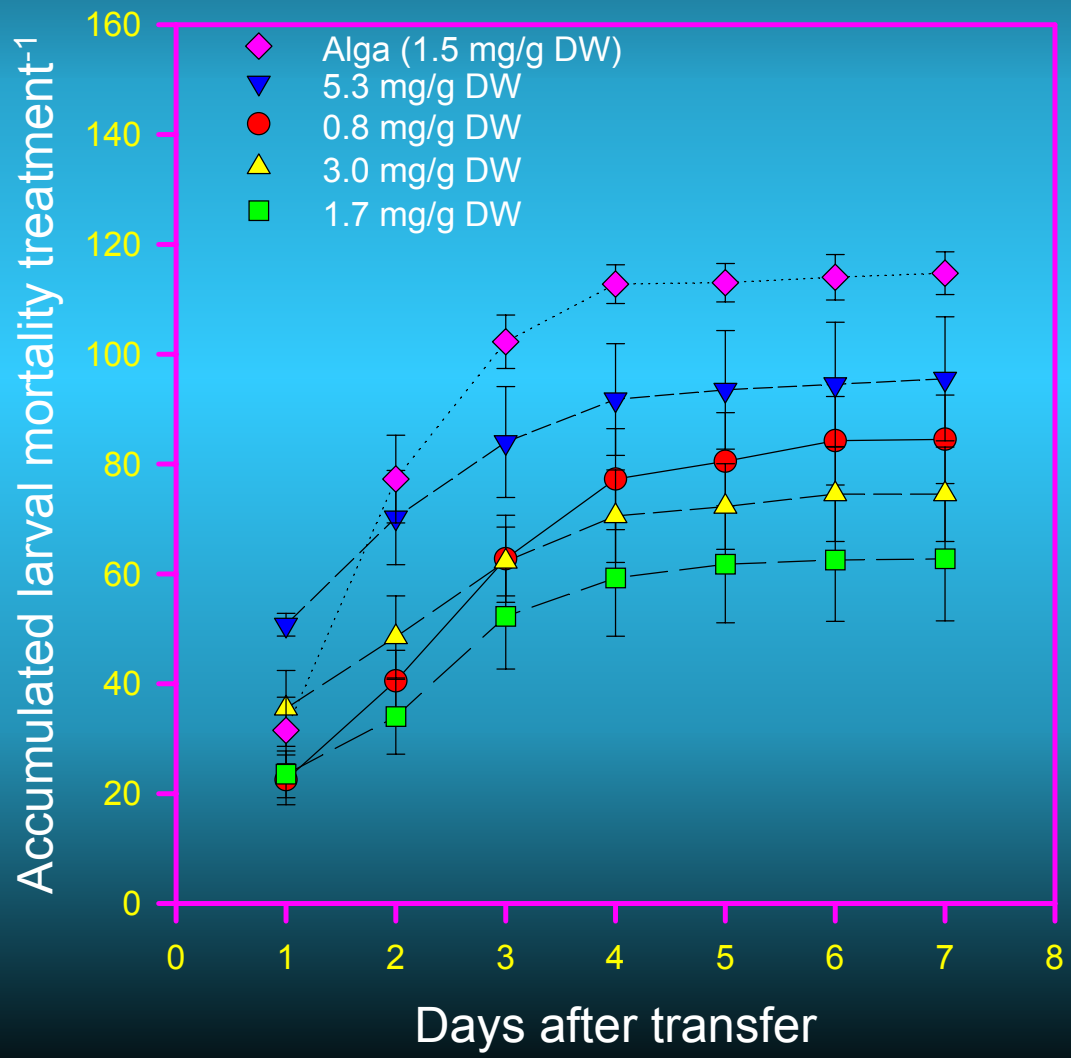
400 L V-tanks
40,000 eggs/tank
rotifer feeding

27 L aquaria
200-300 larvae/aquarium
Artemia feeding

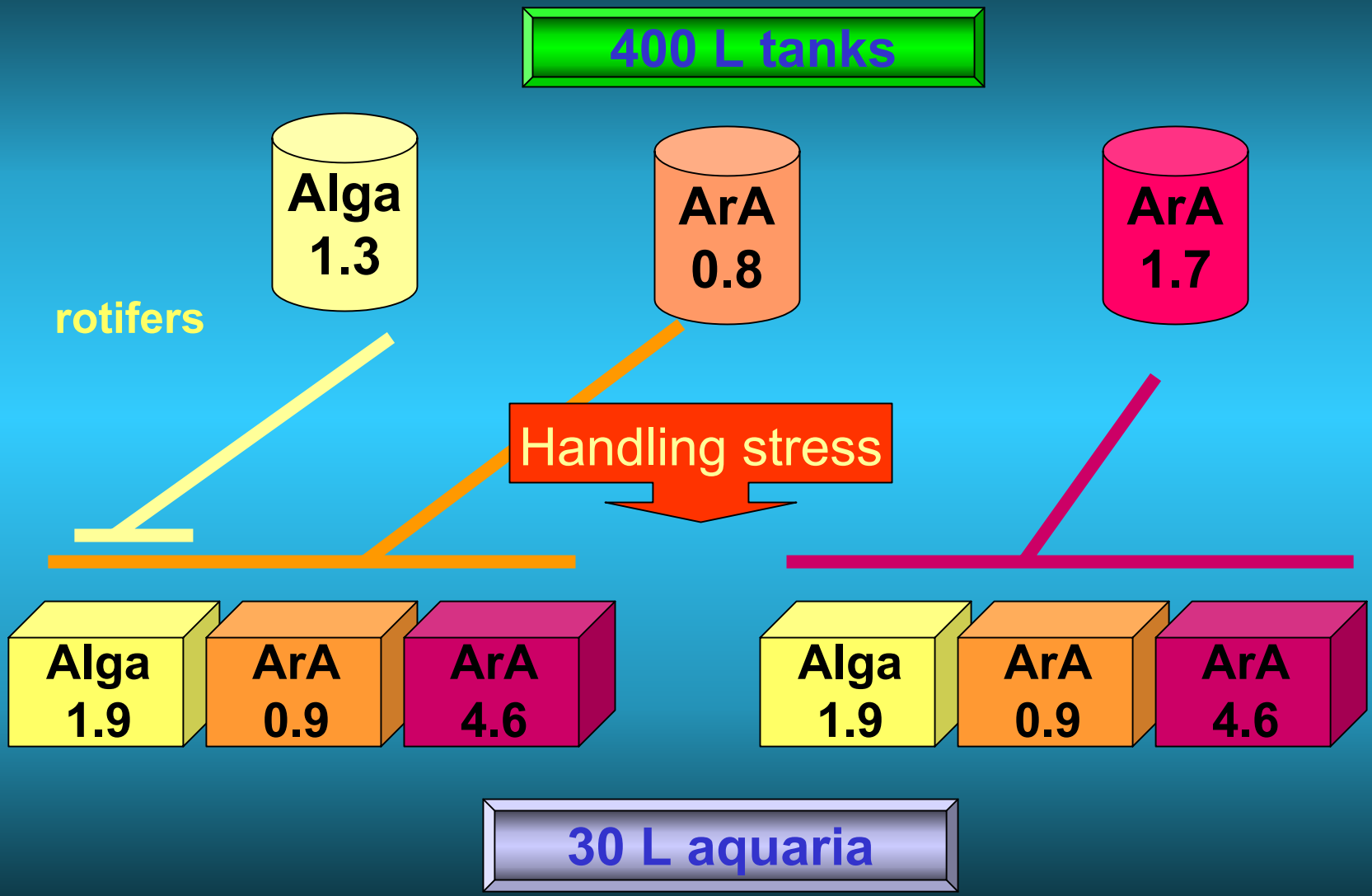
Effect of ArA during rotifer feeding



Accumulated larval mortality in ArA treatments following transfer to aquaria

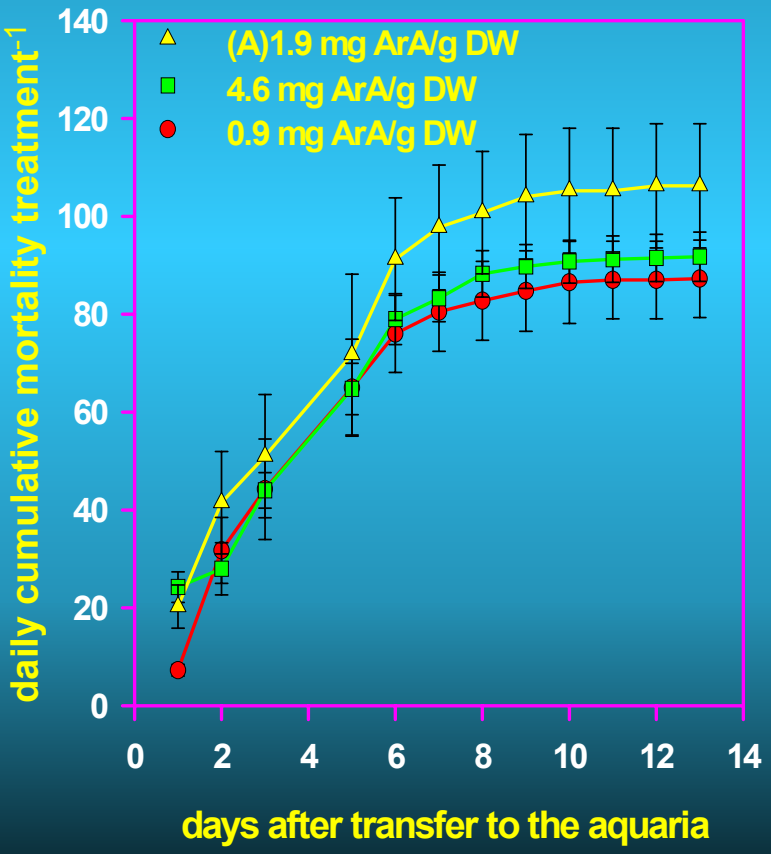


Effect of ArA in rotifers and Artemia

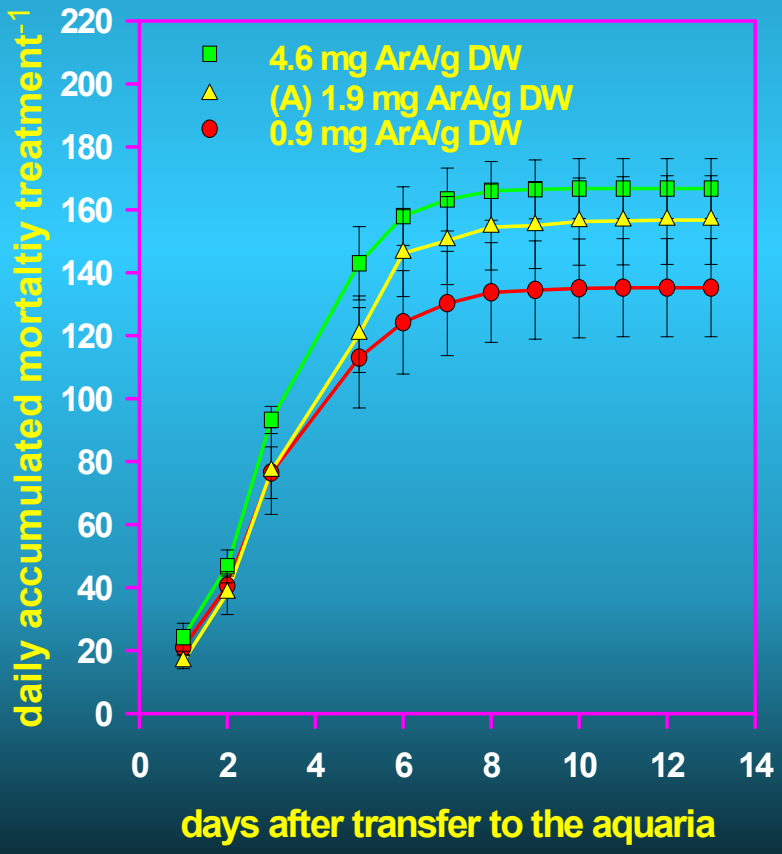


Accumulated mortality, as a result of Artemia treatment, in larvae fed the (a) 1.7mg ArA and (b) 0.8mg ArA rotifers

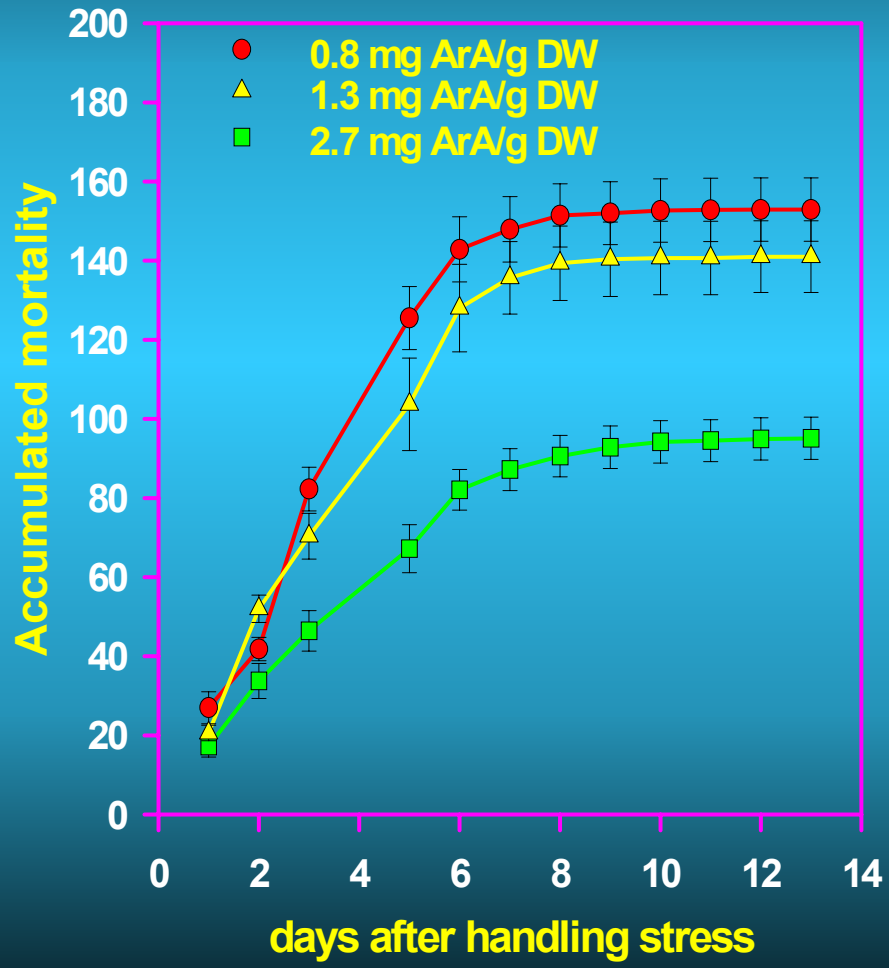
(a)



(b)



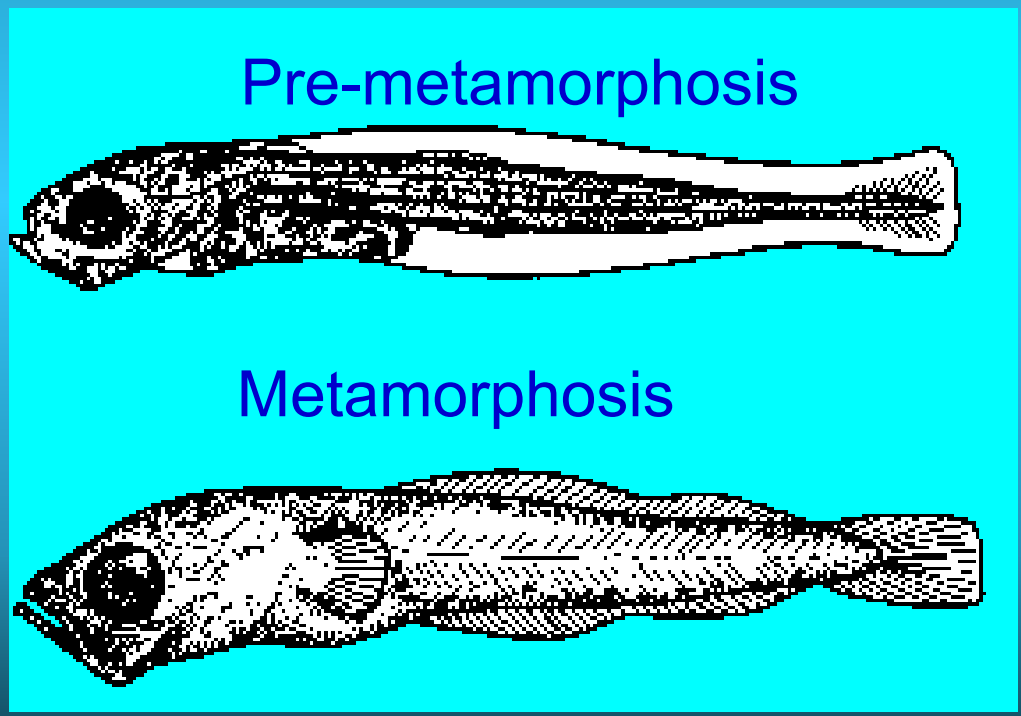
Accumulated mortality in seabream larvae as a result of ArA levels in rotifers fed prior to handling stress



Conclusions from these studies

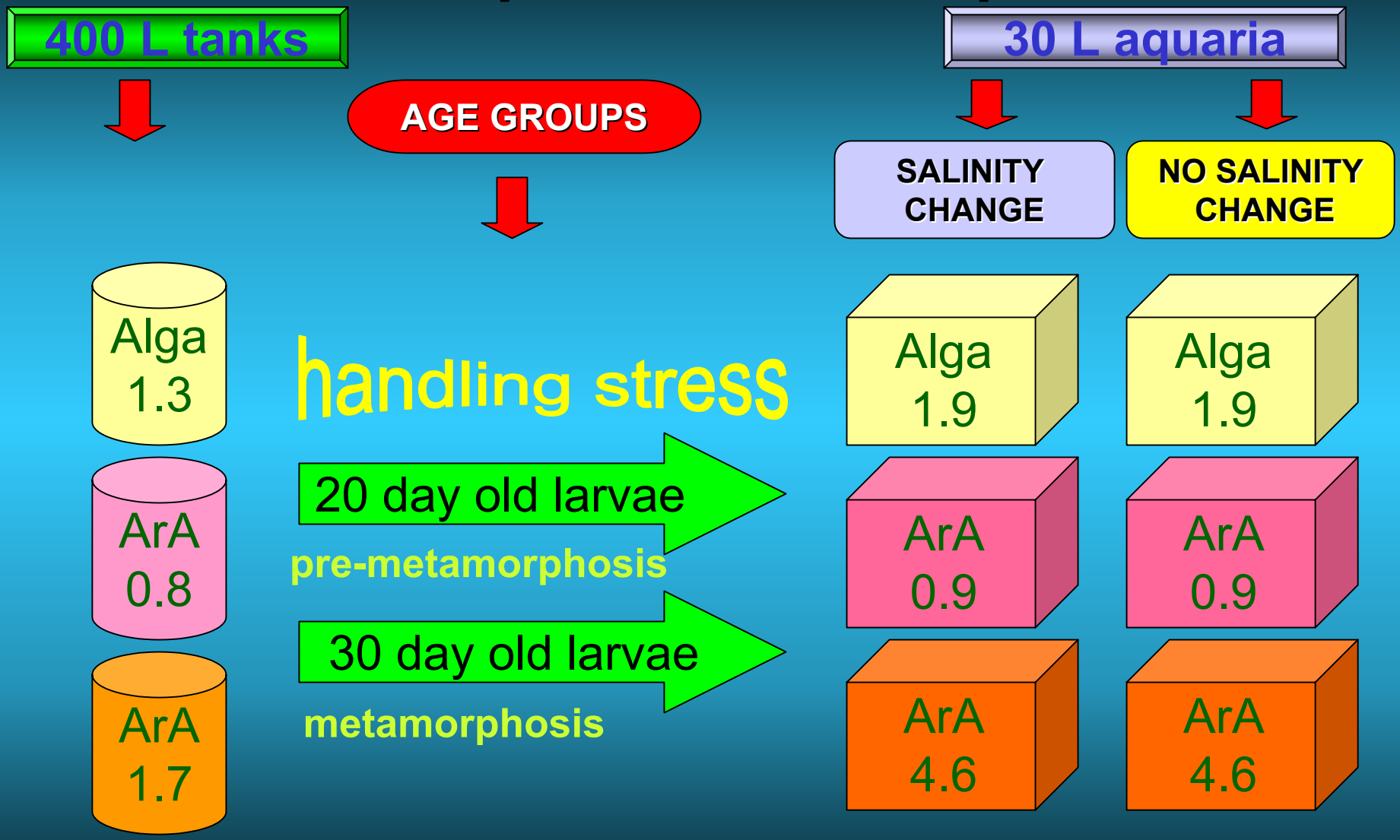
- Dietary ArA improved resistance to handling stress
- Dietary ArA fed prior to stress more effective than when fed after stress.

Does the effect of ArA vary with larval development and/or stress type?



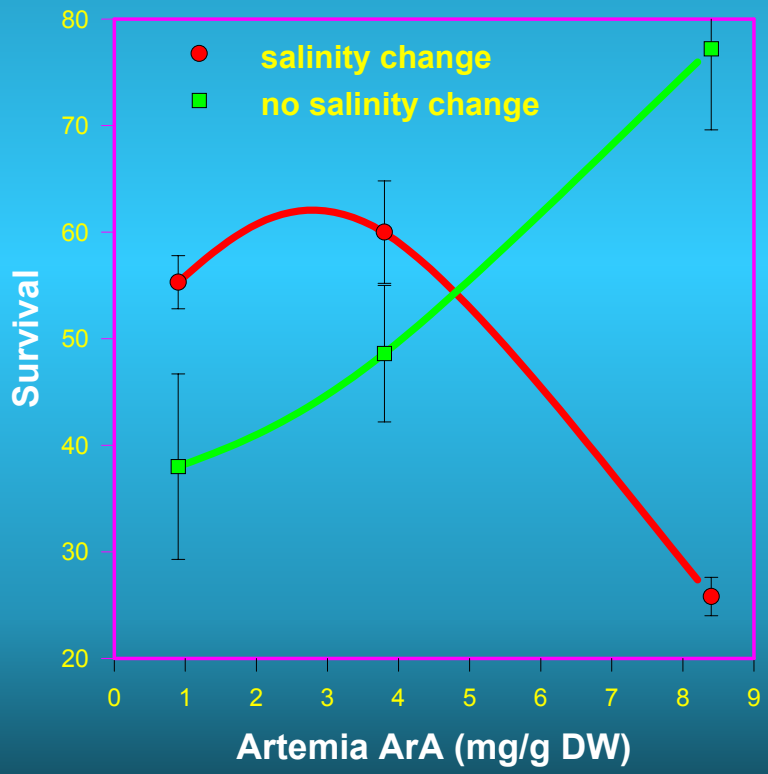
From M. Jobling,1995

Experimental setup

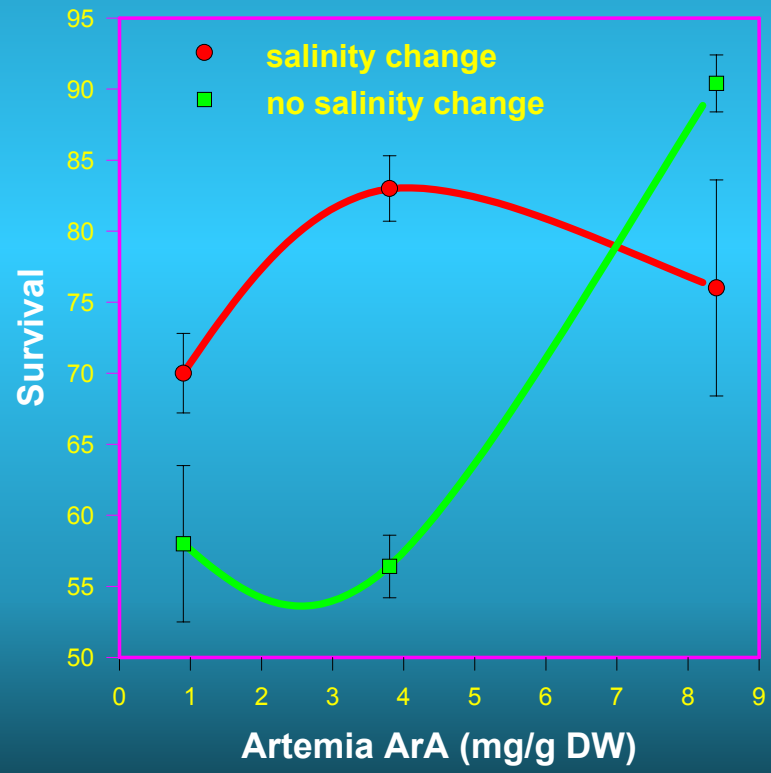


The effect of dietary ArA on survival in larvae exposed to chronic salinity change or no salinity change

pre-metamorphosis
20-30 days

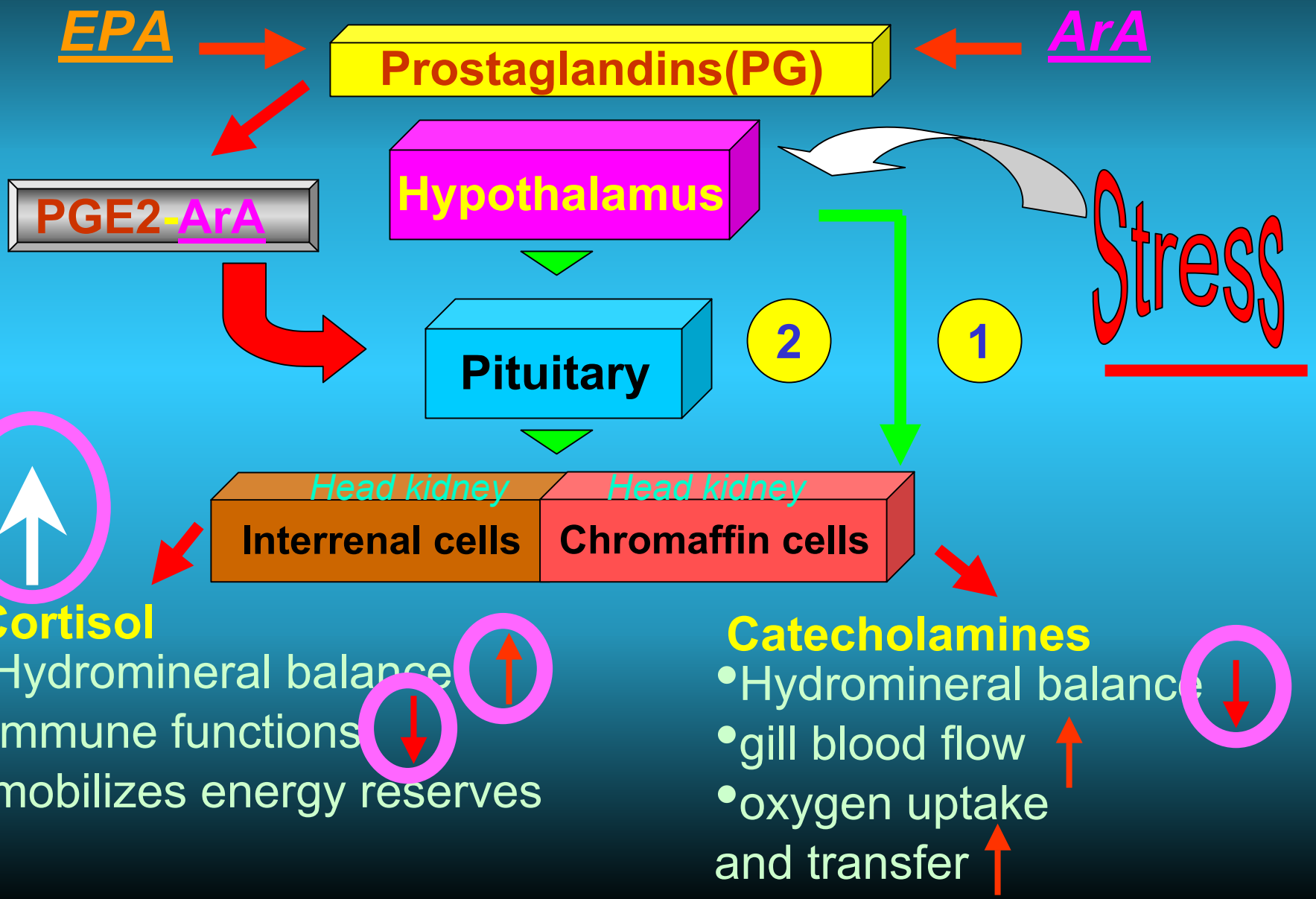


metamorphosis
30-40 days

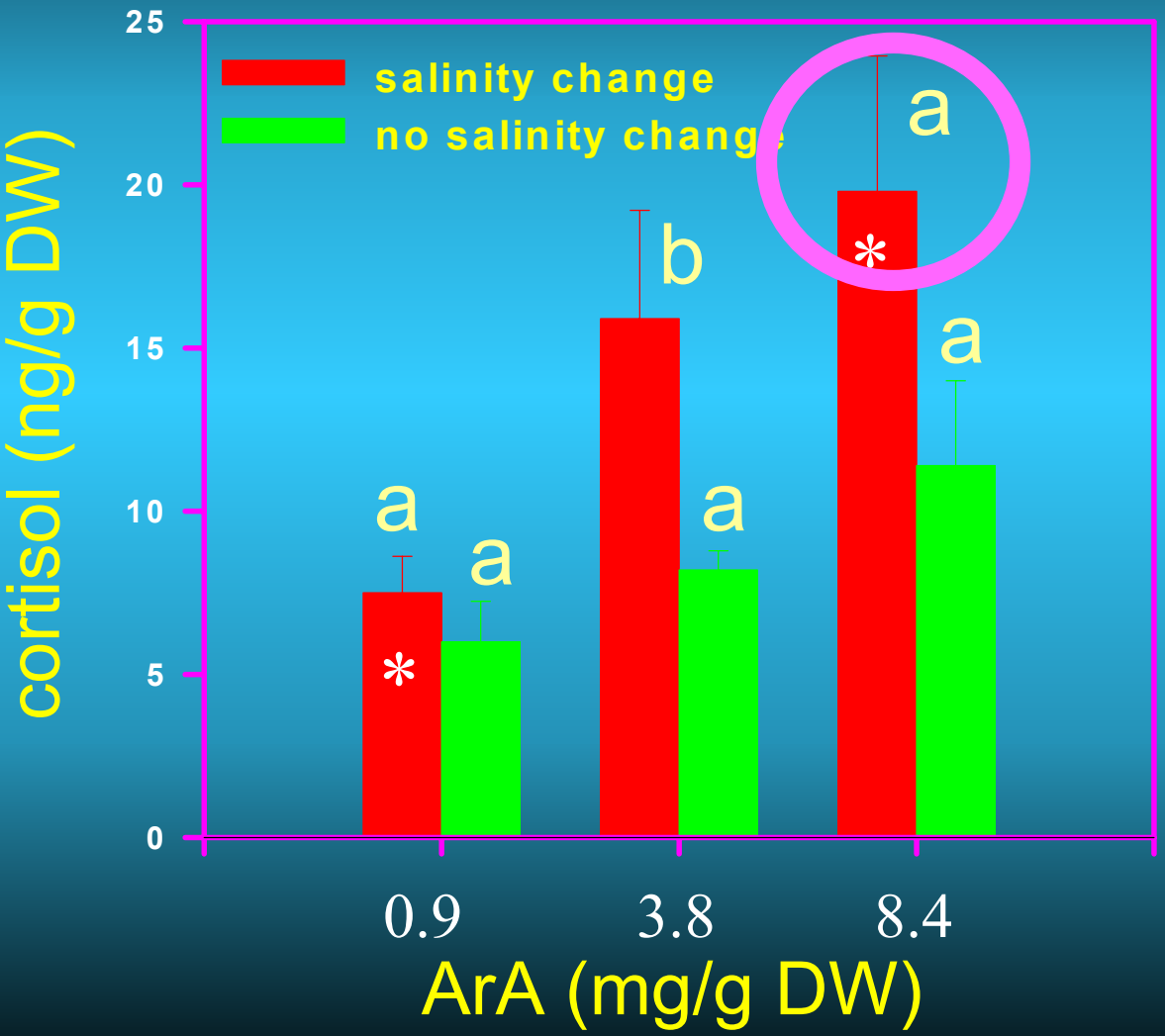


Why does dietary ArA correlate with improved larval survival in the no salinity change group but shows a negative correlation in the salinity change group

The suggested role of Arachidonic acid (ArA) in the HPI axis during the stress response



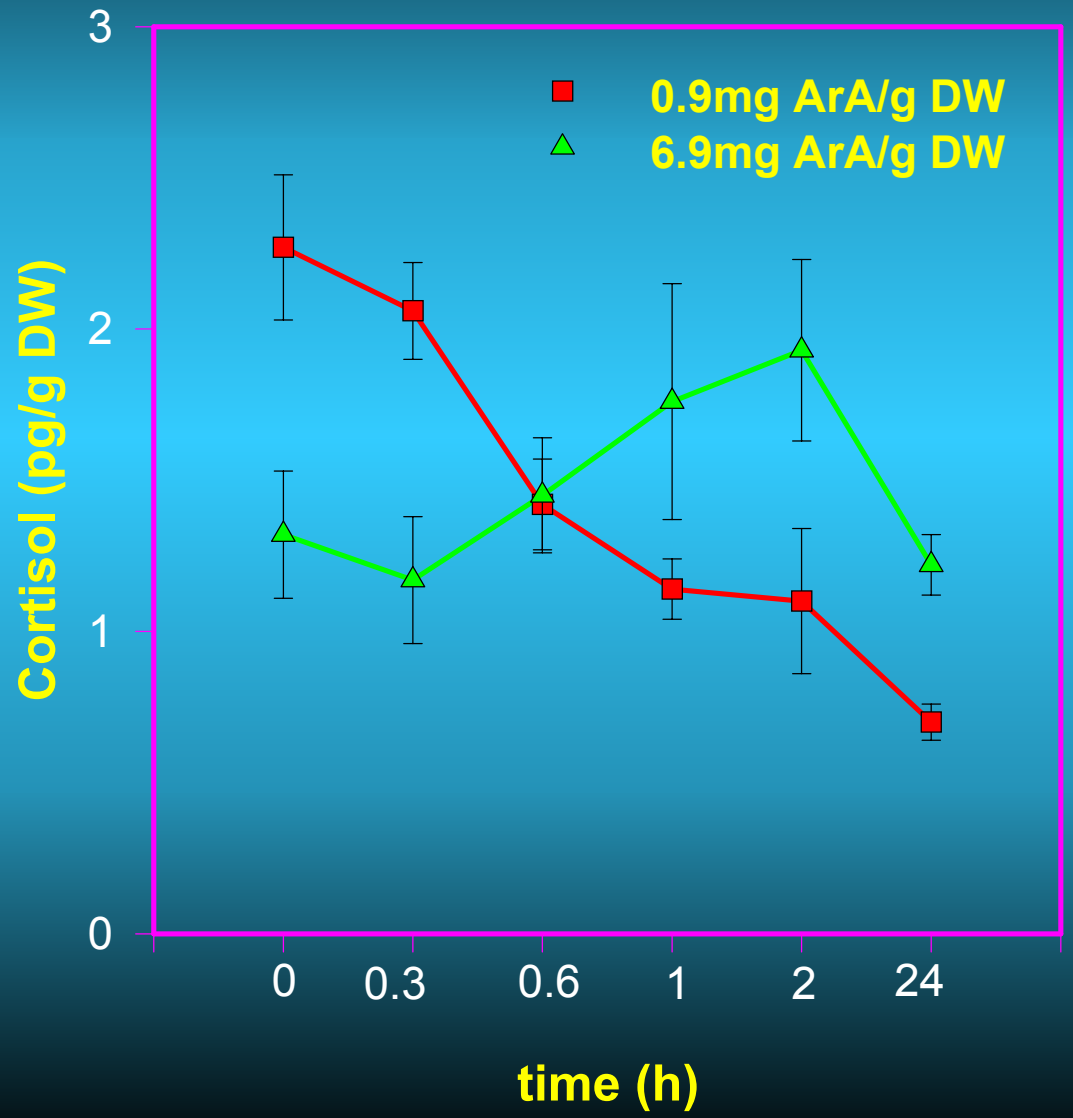
Cortisol basal levels 10 days after transfer of 30 day old larvae to aquaria



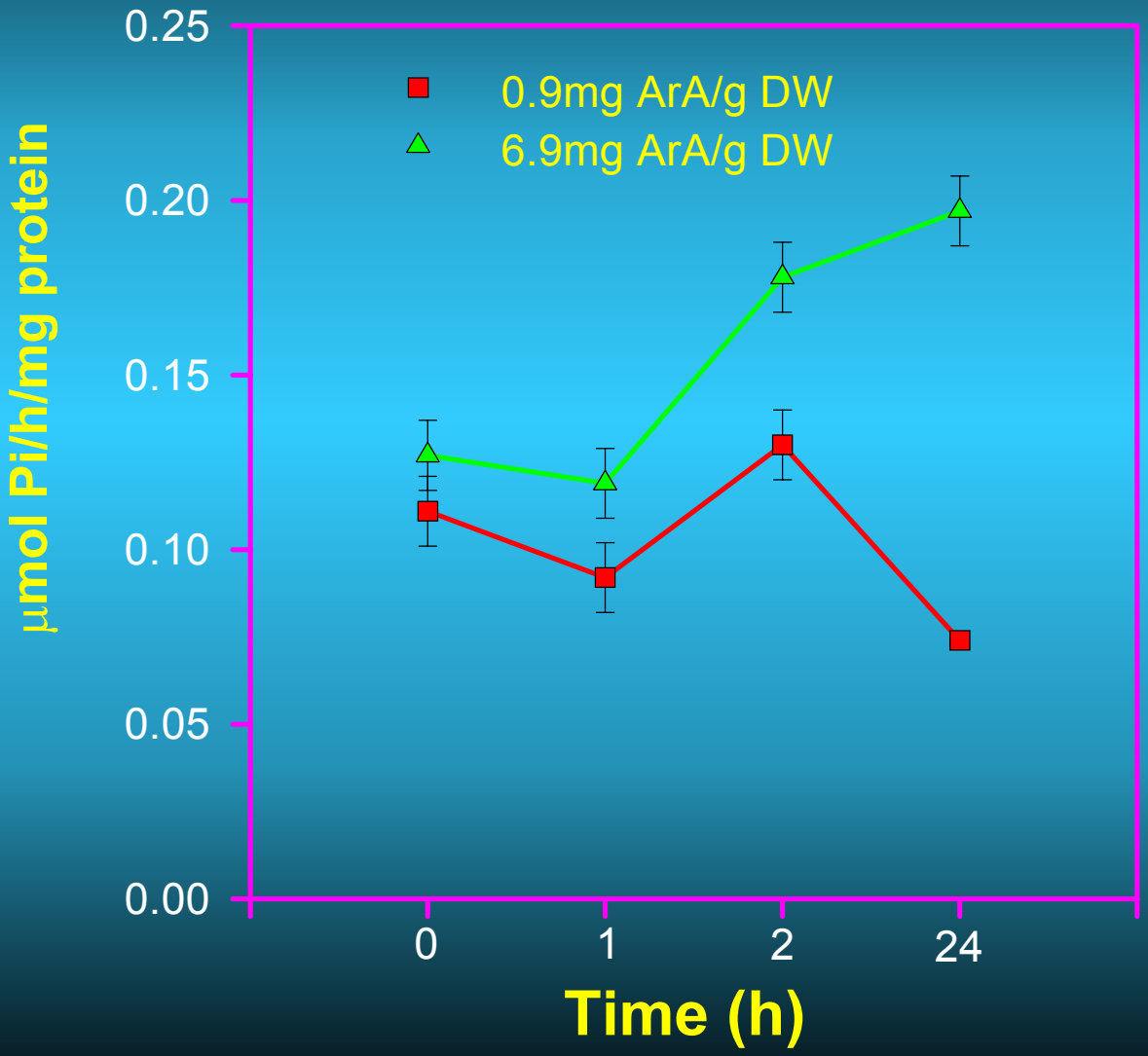
- These studies showed ArA effect on basal cortisol levels after acclimation to salinity and/or handling stress.

- In a following study, larvae were fed for 10 days on ArA poor or ArA rich nauplii. The salinity was then reduced from 40-25 ppt over 1 hour and the stress response was followed over time.

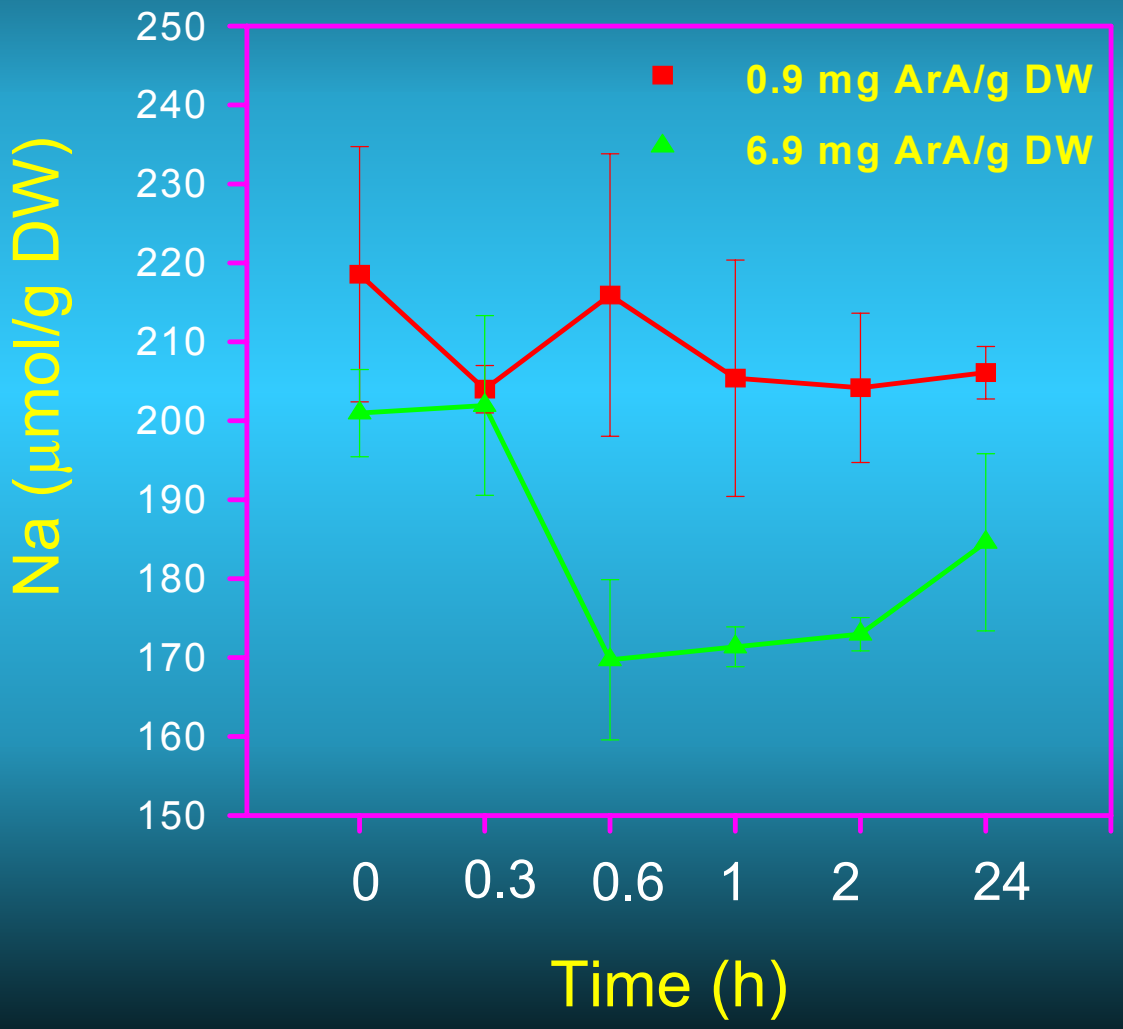
Cortisol response to salinity change (40-25 ppt within 1h)



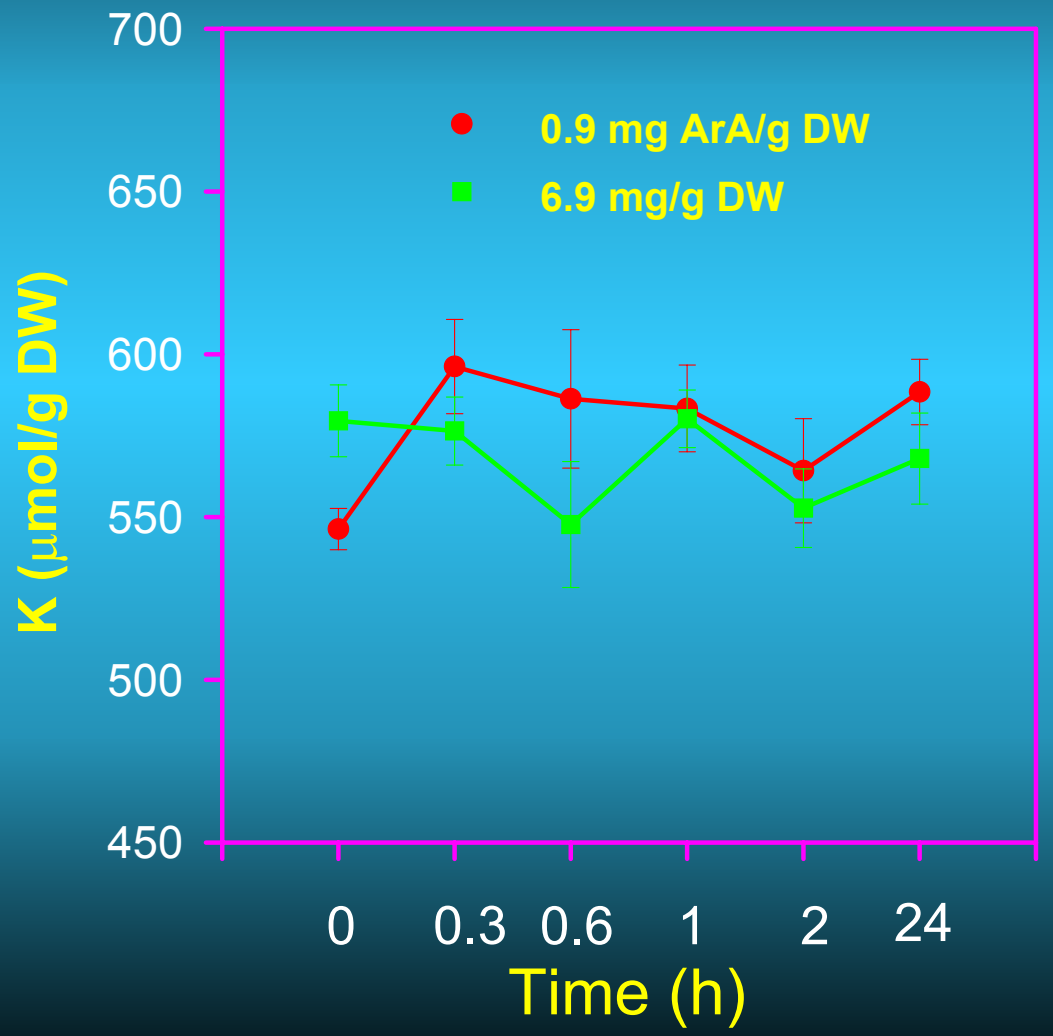
Na^+/K^+-ATPase response to salinity change (41-25 ppt within 1h)



Whole body sodium levels in response to salinity change (41-25 ppt within 1h)



Whole body potassium levels (41-25 ppt within 1h)



Current conclusions

- ArA improves survival following an acute stress event if fed prior to the event.
- ArA may be most effective during metamorphosis.
- ArA, as a precursor to PGE_2, is involved in regulation of basal cortisol levels and cortisol levels during the stress response.
- Improves stress resistance by regulating osmoregulation.
- High levels of ArA can be detrimental during chronic stress.

Special Thanks

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Body osmolarity of Sparus aurata larvae after abrupt transfer from 40 to 25 or 15 ppt