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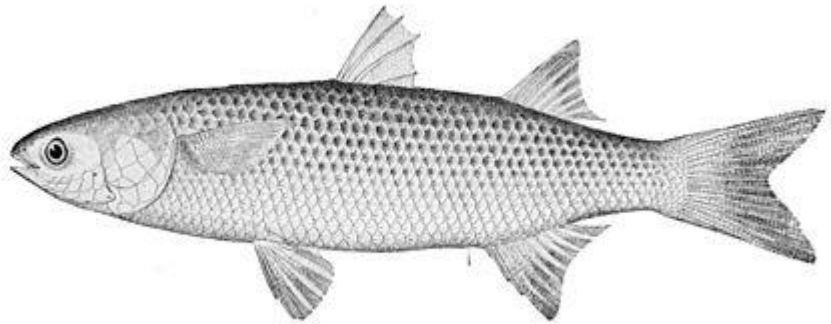
The transition from carnivorous to omnivorous feeding and its implications in larva and juvenile rearing of grey mullet

Bill Koven, Enric Gisbert, Oriya Nixon, Iris Meiri-Ashkenazi, Aviad Gaon, Michael M. Solovyev, Amos Tandler, Hana Rosenfeld



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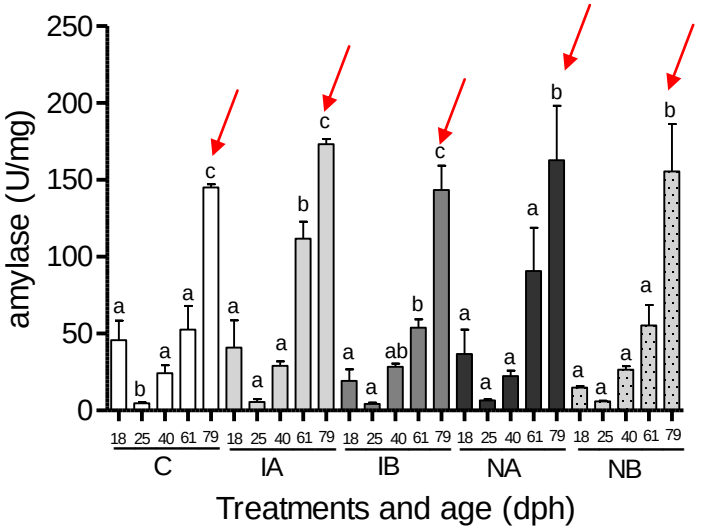
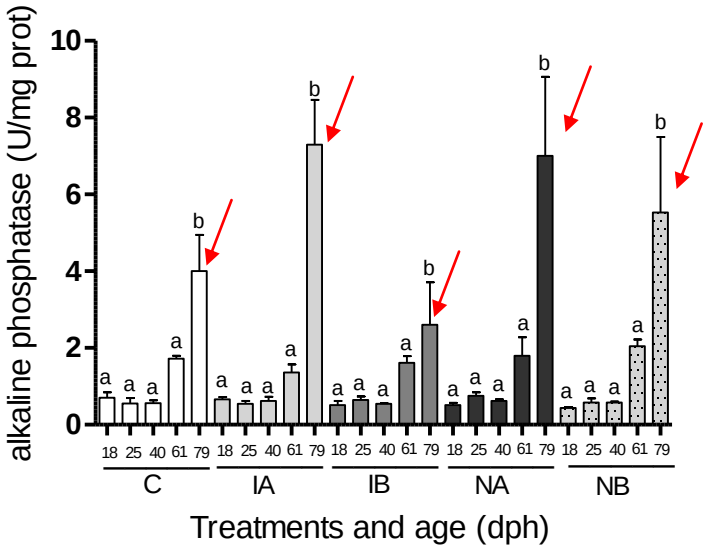
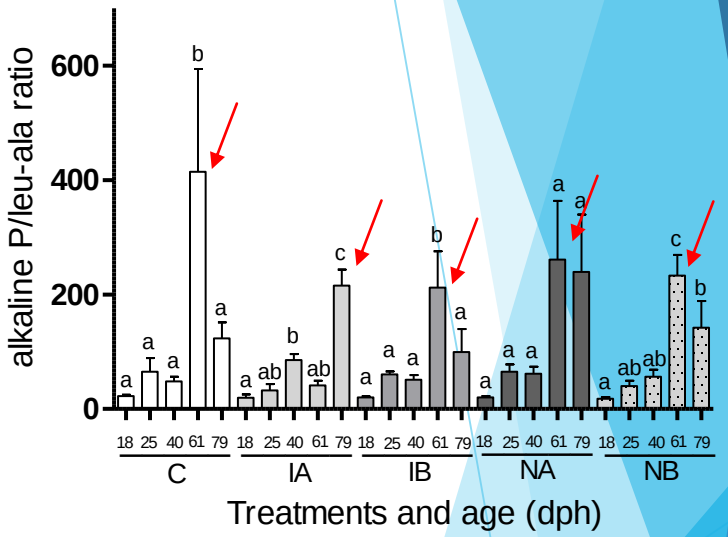
Background

- Grey mullet larvae strict carnivores feeding on zooplankton.
- After metamorphosis change to herbivorous/omnivorous diet-searching for less saline estuaries with higher primary productivity of micro and macroalgae.
- Earlier study investigated the effect of greening tanks with different concentrations of *Isochrysis galbana* and *Nannochloropsis oculata* during larval rearing on DT enzyme ontogeny in 25, 40, 61 and 79 dph juveniles.
- No clear effect of algae addition was observed on enzyme ontogeny but the DT enzyme ontogeny with age was revealed.

Earlier study: Effect of algal turbidity on DT enzyme ontogeny







- Amylase activity steadily increased to peak at 79 dph. signaling herbivorous/detritivorous feeding,
- alkaline phosphatase (marker for BBM absorption and development) peaked at 79 dph.
- the AP/leu-ala peptidase ratio (indicator of gut maturation) peaked at 61 dph but then declined in 79 dph.

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Background

- IOLR weaning protocol- mullet juveniles can be weaned off live *Artemia* to a dry, prepared diet from 24-37 dph.
- Results from the earlier study indicated this weaning period overlaps trophic shift from carnivory to a more carbohydrate rich diet.
- **Question:** Should the weaning diet satisfy a carnivorous, omnivorous or herbivorous mode of feeding?

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Aim

Evaluate the effect of feeding a carnivorous, herbivorous or omnivorous weaning diet to juvenile mullet on;

(a) growth, survival and population weight distribution

(b) the ontogeny of pancreatic, brush border and cytosolic enzyme activity.

Experimental design

- Fifteen 17 l aquaria in a flow through system with 40 ‰, UV treated temperature (24.5 ^{0} C) controlled seawater were stocked with eighty-five 23 dph larvae aquarium^{-1}.
- Tested three weaning dietary treatments, differing in their protein and carbohydrate content, in replicates of 5 aquaria treatment^{-1}.
- Diet 1 dried *Ulva lactuca* (35% plant protein, 56% carbohydrate),
- Diet 2 commercial starter diet “caviar”(Bernaqua, Belgium; 55% animal protein, 8% carbohydrate)
- Diet 3 1:1 w/w mixture of diets 1 and 2.

Dph	Rotifers	Artemia	Dietary treatments	Size (µm)	*Nannochloropsis oculata*
23	x2 day	x2 day	0	-	4x10^{6} cells\ml
24-25	x2 day	x2 day	X1	50-100	4x10^{6} cells\ml
26-33	0	x2 day	x2 day	100-200	4x10^{6} cells\ml
34-37	0	x2 day	x3 day	200-300	0
38-53	0	0	x5 day	200-500	0

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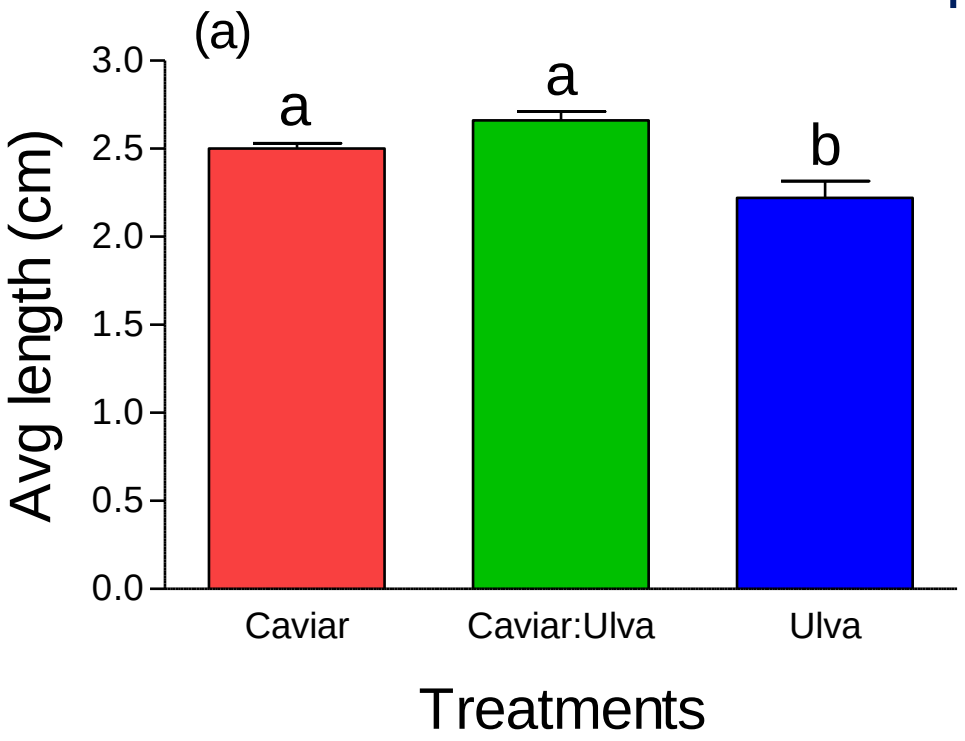
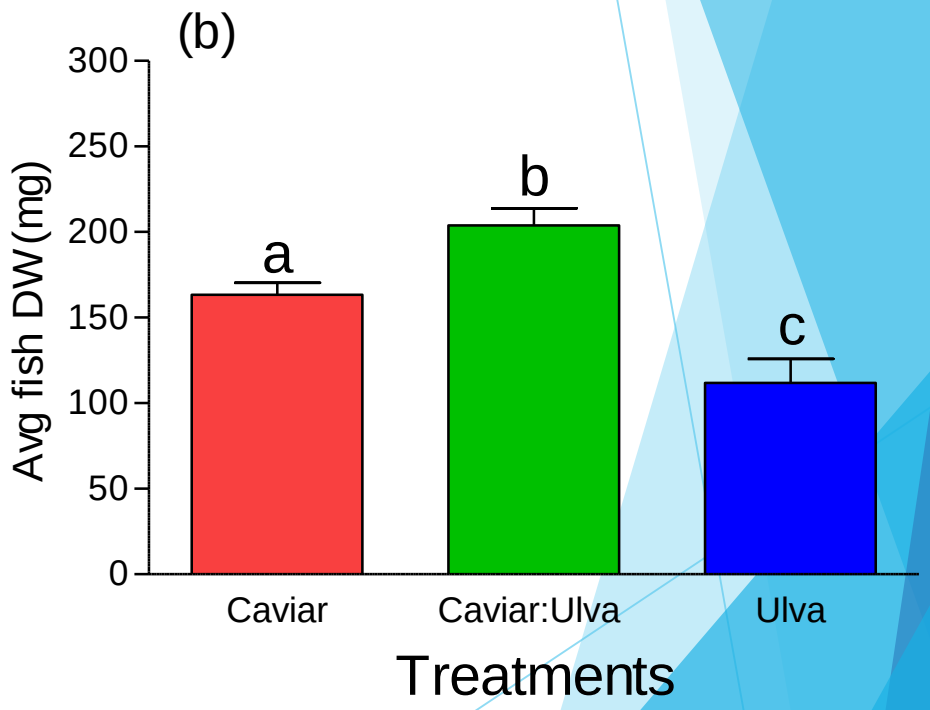
Effect of the Caviar, Ulva and Caviar: Ulva on (a) 53 dph fish length and (b) dry weight (DW) at the end of the experiment.





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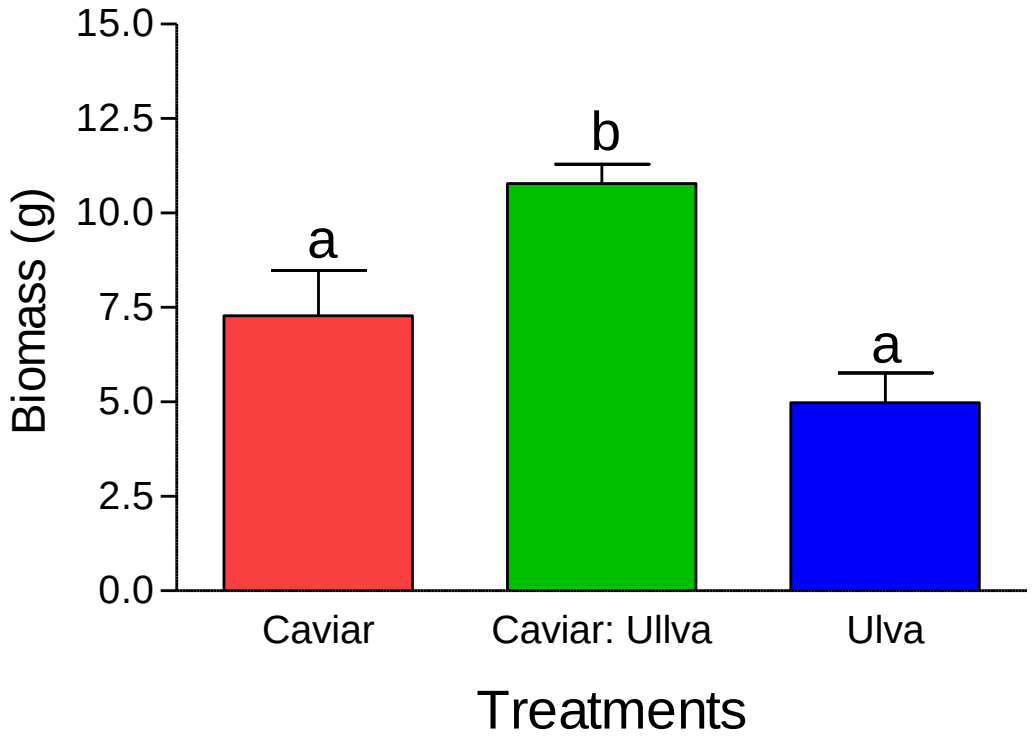
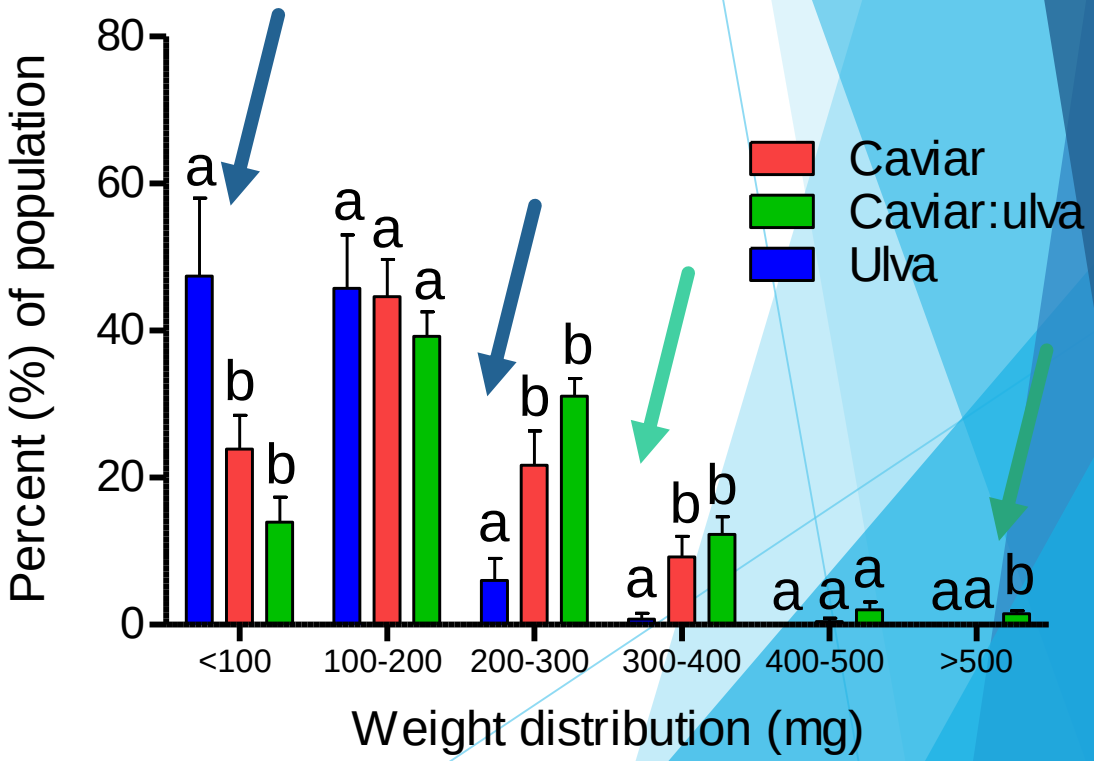
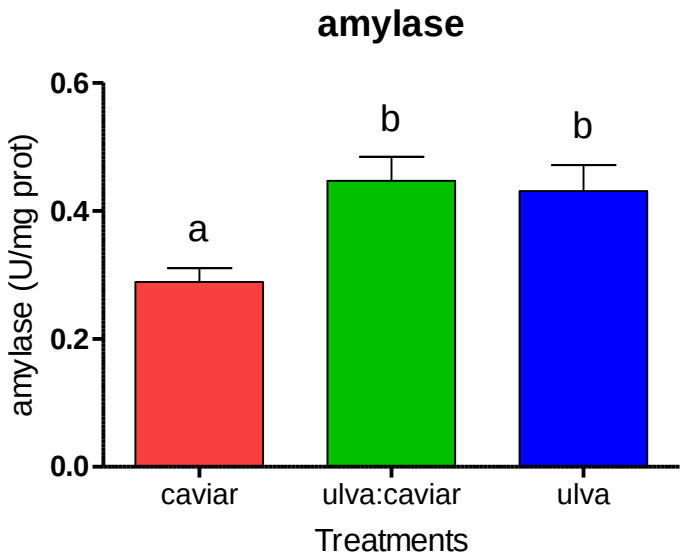
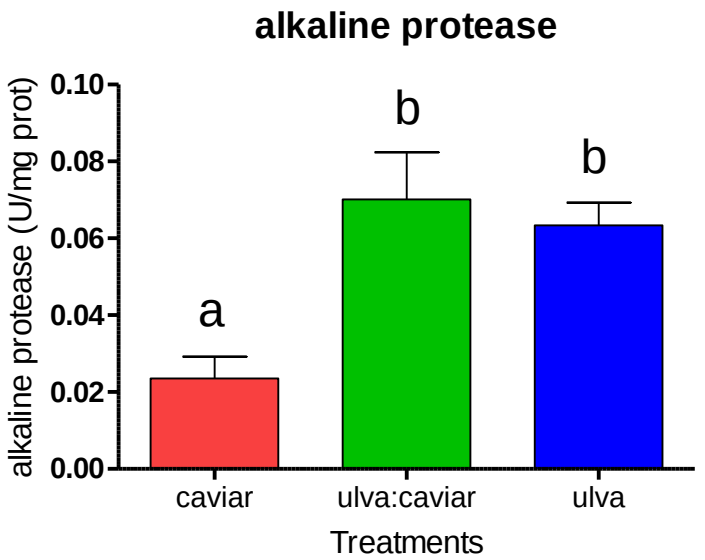
Effect of diets on biomass and weight distribution

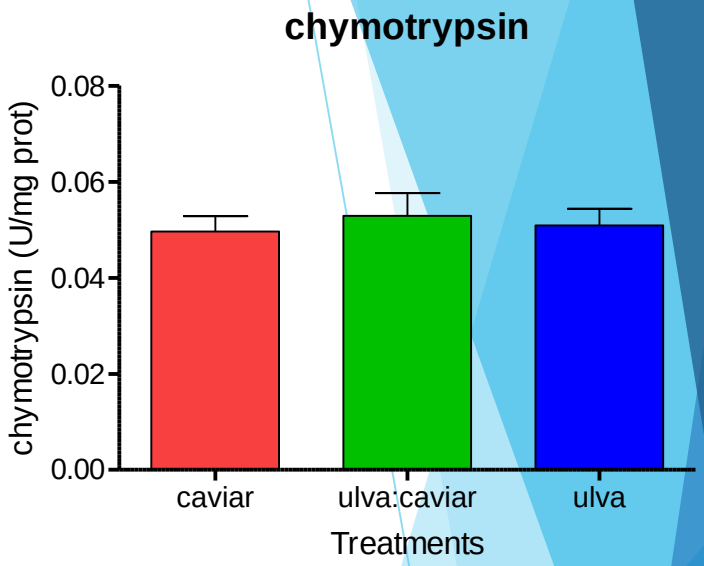


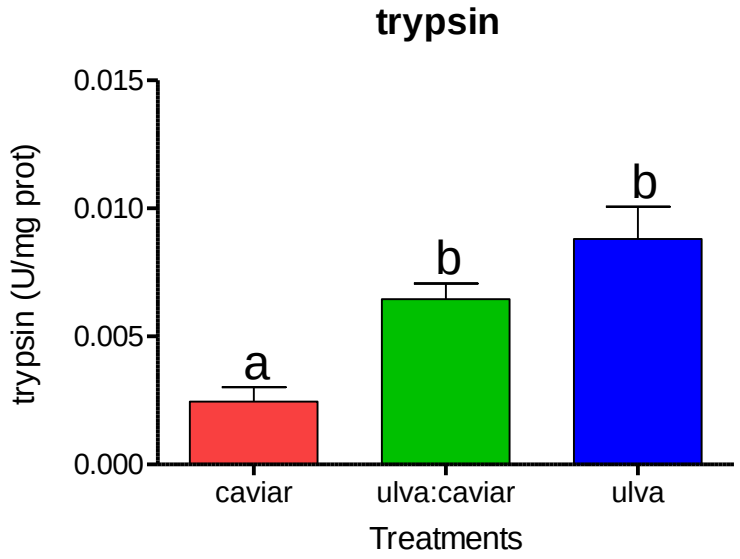


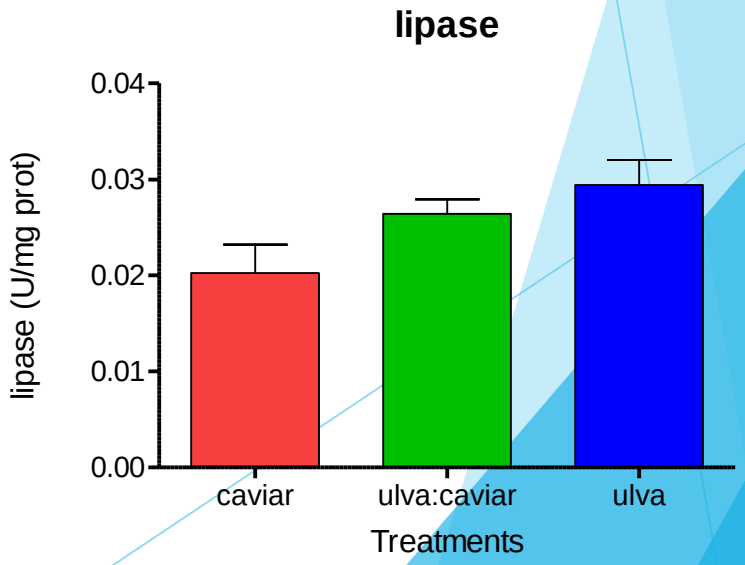
Pancreatic enzymes



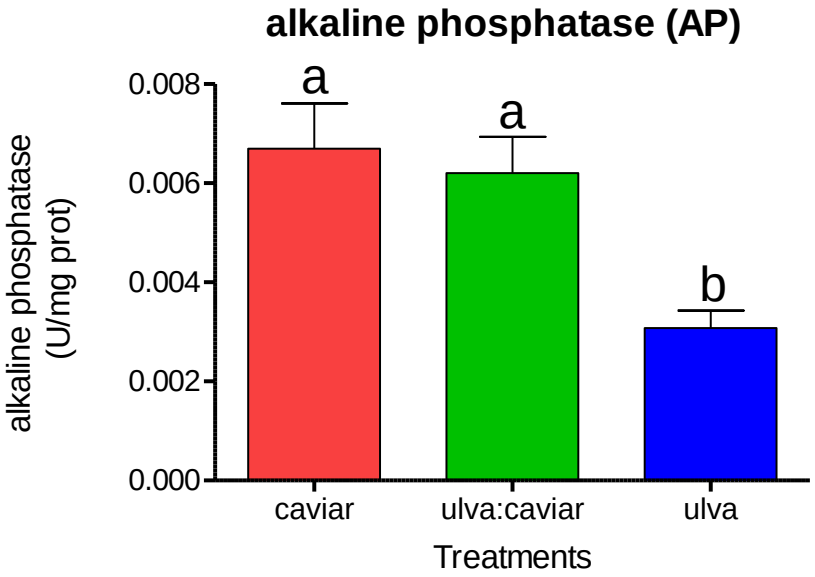


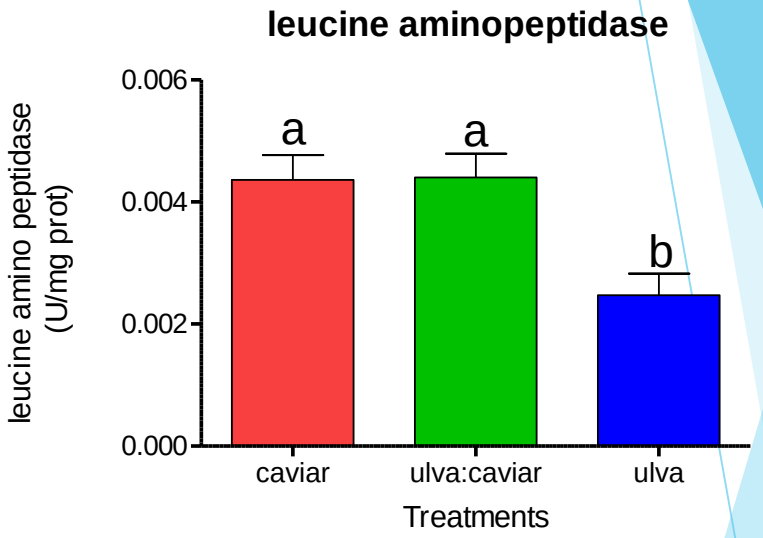


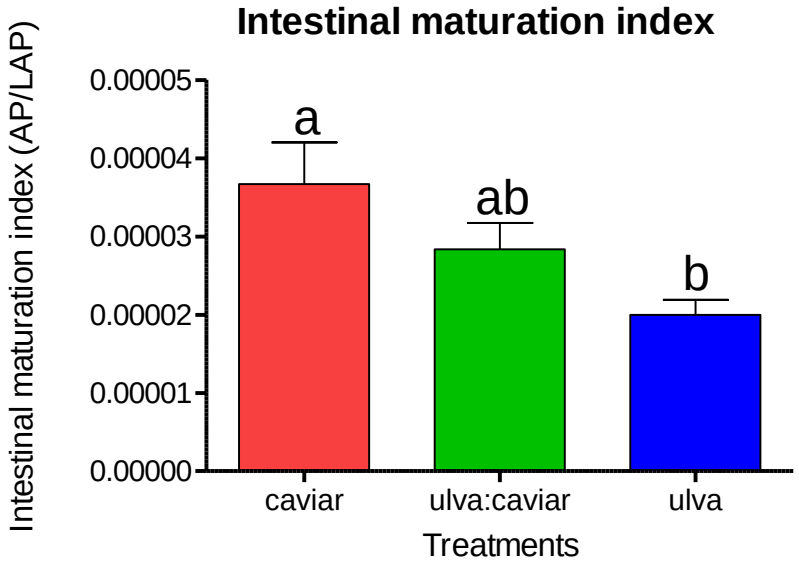


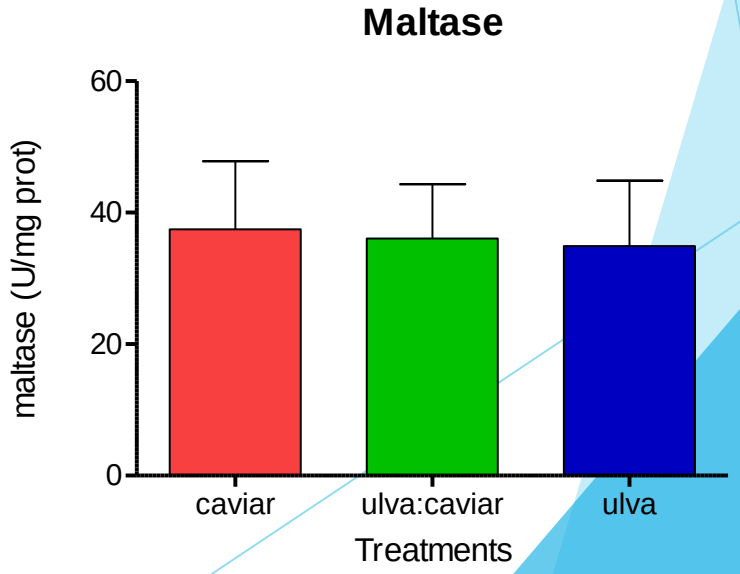


Brush border and cytosolic enzymes









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Summary

- caviar:ulva diet – best performance (length, dry weight, tank biomass
- Ulva diet – more smaller fish (<100 mg), less larger fish (200-400 mg).
- caviar and caviar:ulva – more larger fish (300-400 mg)
- Increasing dietary cho:pro ratio significantly increased pancreatic amylase, protease and trypsin. Chymotrypsin and lipase independent of cho:pro ratio.
- BBM enzymes AP (alkaline phosphatase) and LAP (leucine aminopeptidase) increased nutrient absorption and maturation with higher dietary accessible protein in nutrient dense diet.
- Decreasing AP/LAP with increasing CHO suggests gut maturation decreases with more ulva in diet.

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Conclusions

- Enzyme specific activity affected by feed composition.
- Most effective diet was omnivorous based, in terms of DW, length, tank biomass, size distribution and enzyme capability.

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Recommendation

- Recommend an omnivorous weaning diet (*ca* 45% protein, 32% carbohydrate) during this stage of development in juvenile grey mullet.

Take home

- Optimum diet -considerable levels of protein for growth and starch to provide glucose for energy to spare protein from catabolism and direct it toward growth.

- Mimic natural omnivorous diet of mullet in estuaries.

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