Defining the optimal docosahexaenoic acid (DHA) requirements of juvenile barramundi, *Lates calcarifer* - a key diadromous aquaculture species

Food Futures Flagship

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Stream Leader - Novel Feed Ingredients and Nutrition

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Background

- Most fish have a limited capacity for DHA synthesis:
  - Some variability in capacity among species
  - Dietary derived DHA main source of this fatty acid
  - Absence from diet usually results in an array of metabolic aberrations
- Increasing pressure on fishery derived oils is increasing the use of alternatives
- Essential fatty acid requirements for most farmed fish are poorly defined

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Methods

- Diets formulated to:
  - Excess protein, Limited in Lipid – emphasise point of influence
  - Focus on DHA inclusion effects and EPA and ARA at co-inclusion
  - Use only triacylglyceride based fatty acid sources
- Feed intake variability managed through restricted “paired-feeding” regimes
- Fish fed for 6-weeks (n=3 tanks of 15 fish per treatment)
- Fish assayed for growth, feed conversion, tissue composition, plasma chemistry, histology, behaviour

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Diet Formulations

% DHA formulated	0.1%	0.3%	0.6%	1.0%	1.5%	1.8%	Control	ARA
Pre-mix vitamins	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Cellulose	7.6	6.8	6.1	4.6	3.0	1.9	7.7	1.1
Pregelled starch	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Fish oil	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0
Wheat gluten	15.0	14.9	14.8	14.6	14.4	14.3	15.0	14.1
Wheat flour	10.8	10.8	10.8	10.8	10.8	10.8	10.7	10.8
Blood meal	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Soy Protein Isolate	15.0	14.9	14.7	14.4	14.2	14.0	15.0	14.0
Aquagrow-DHA	0.0	1.5	3.0	6.0	9.0	11.3	0.0	5.3
Aquagrow-ARA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
Defatted Fish meal	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Butter fat	8.1	7.6	7.1	6.1	5.1	4.4	4.5	3.7
SFA	60	58	56	52	48	45	41	43
MUFA	30	30	30	29	29	29	27	27
PUFA	7	7	7	7	6	6	7	8
HUFA	3	5	7	12	16	20	25	21
LOA	6	6	6	6	6	6	6	7
LNA	1	1	1	1	1	1	1	0
ARA	0	0	0	0	0	0	0	10
EPA	1	1	1	1	1	1	14	1
DHA	1	3	6	10	15	18	10	10
n-3	3	6	8	12	17	20	25	11
n-6	6	6	6	6	6	6	6	17

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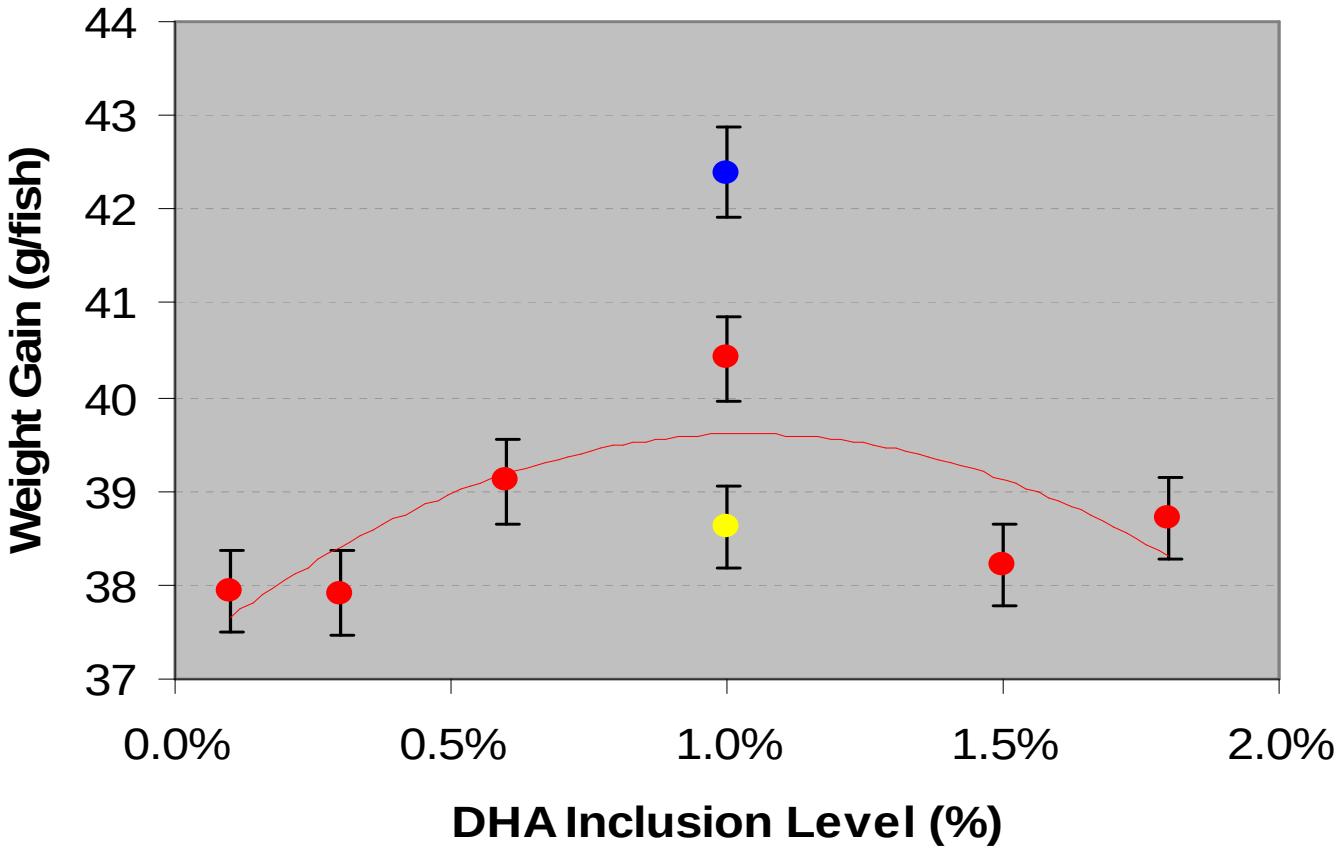
Results - Weight Gain

- 1% DHA + 1% EPA
- 1% DHA + 1% ARA
- DHA only



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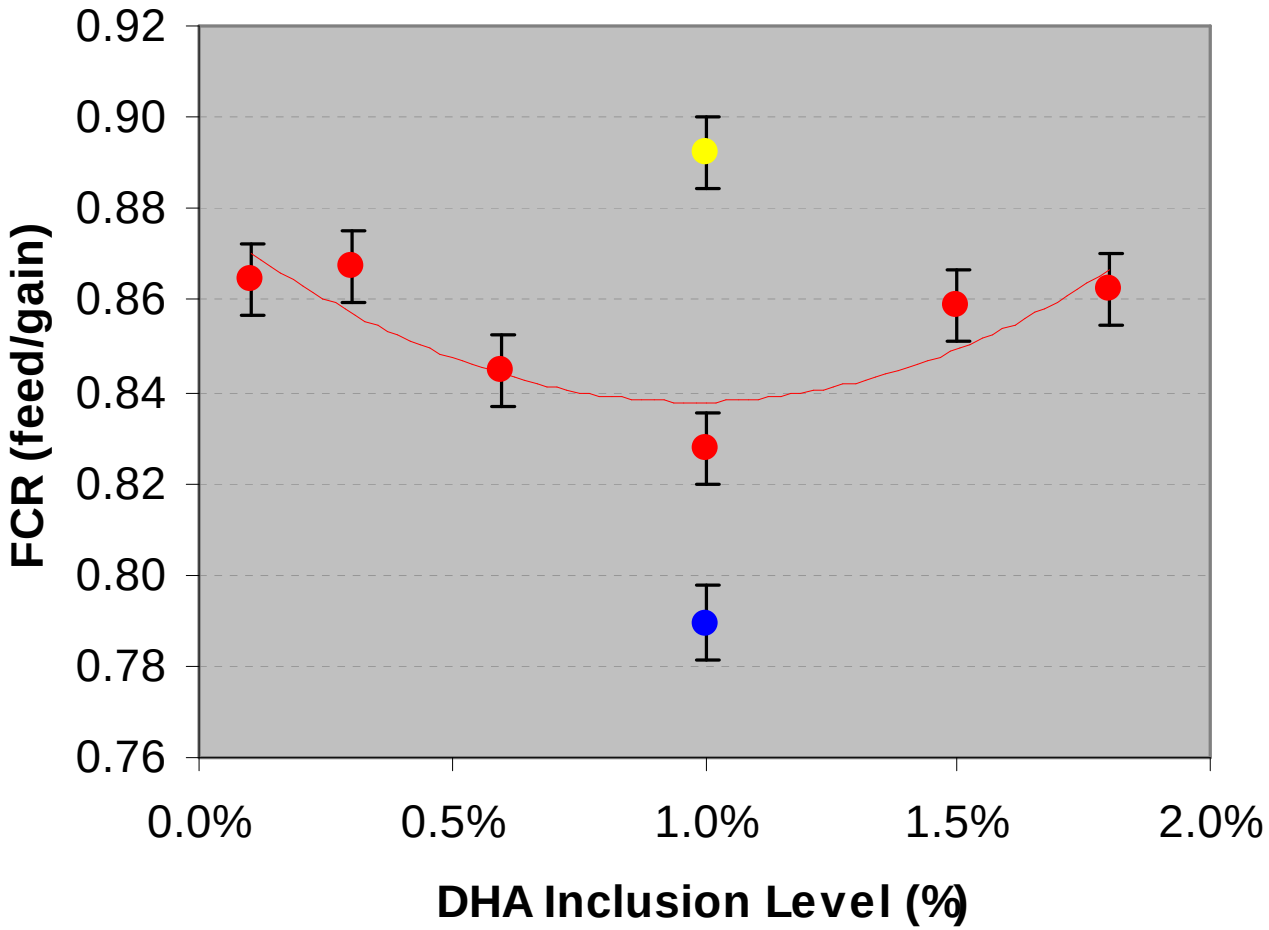
Results - Feed Conversion

1% DHA
+ 1% EPA

1% DHA
+ 1% ARA

DHA only



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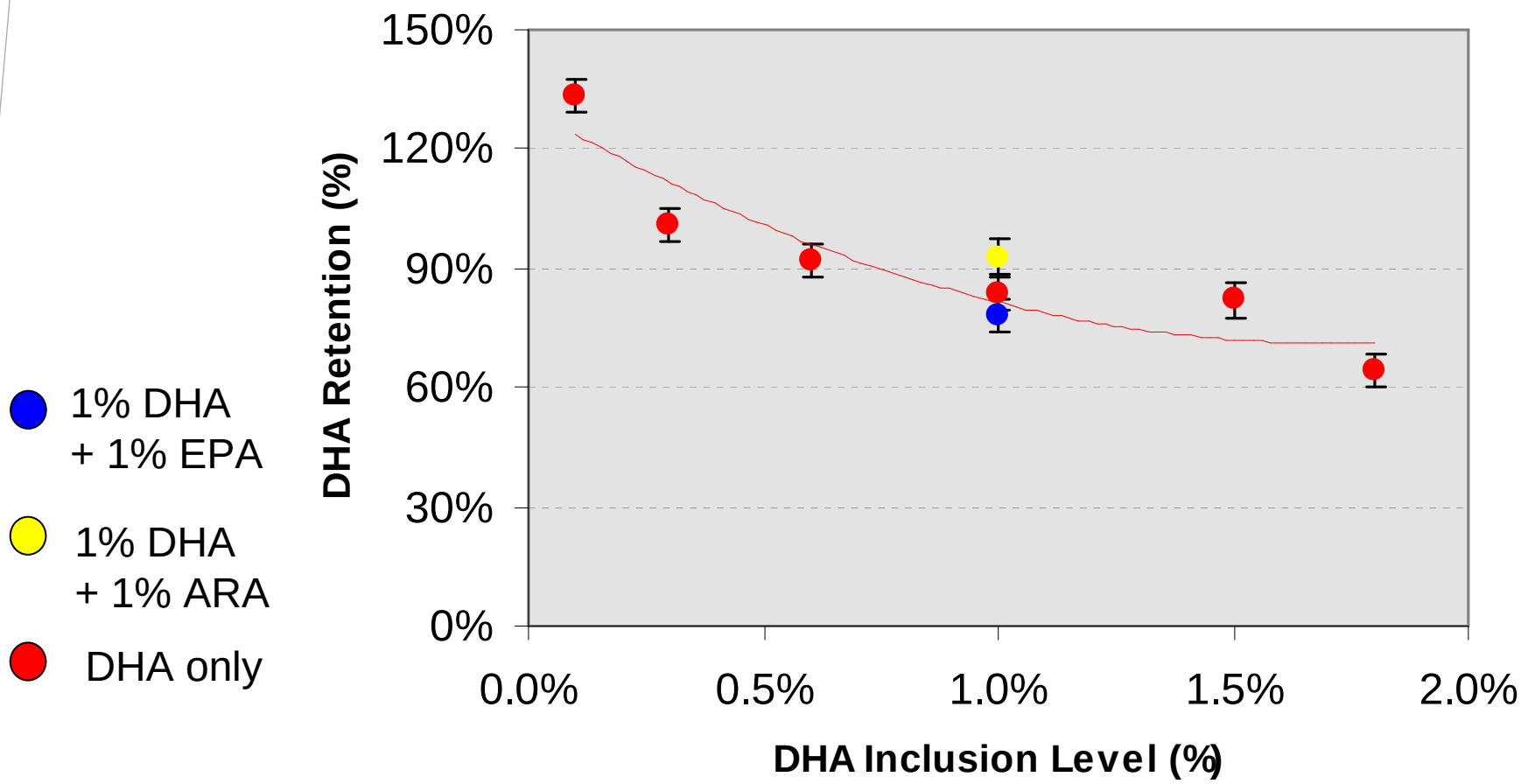
Results - DHA Retention



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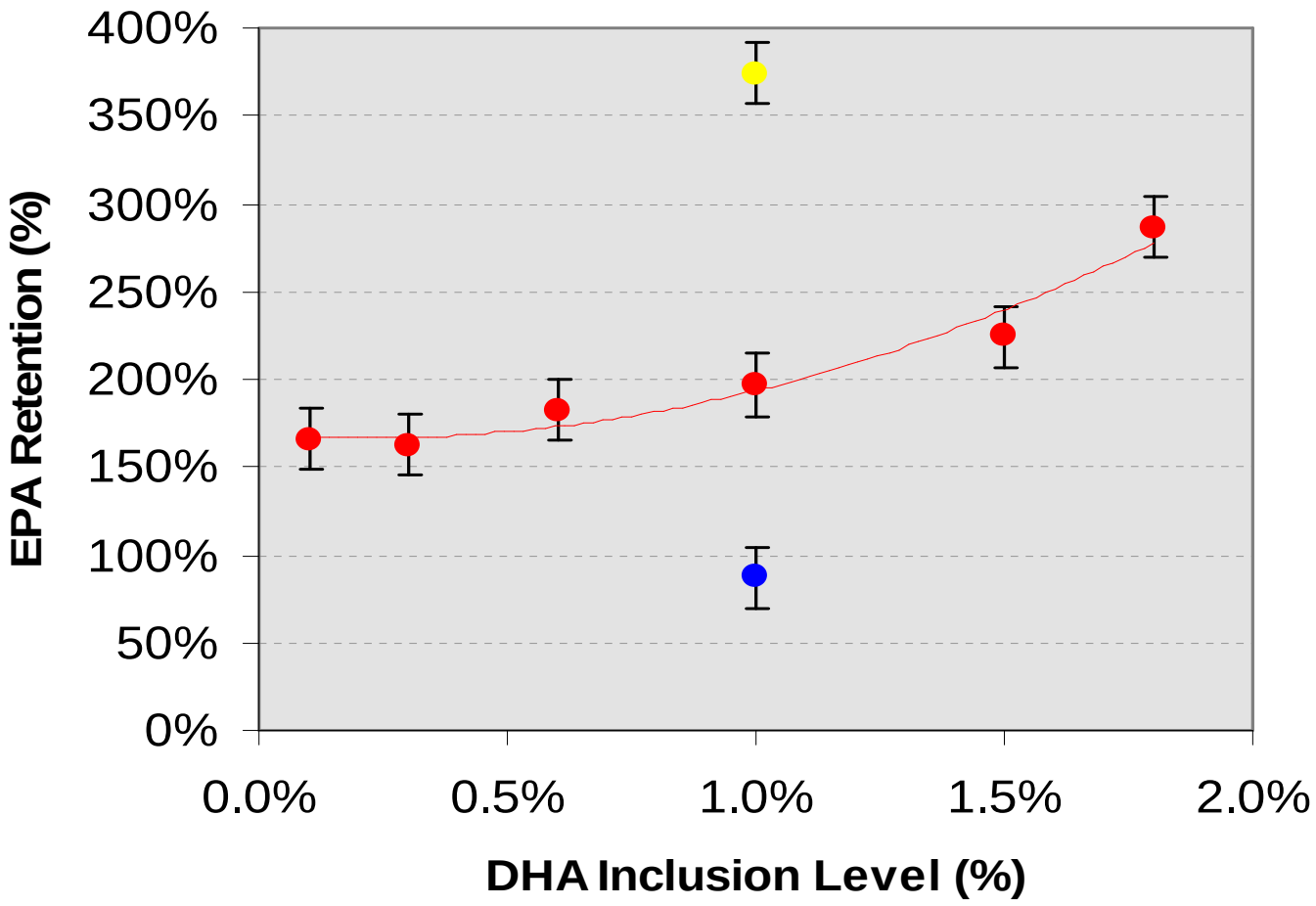
Results - EPA Retention

- 1% DHA + 1% EPA
- 1% DHA + 1% ARA
- DHA only



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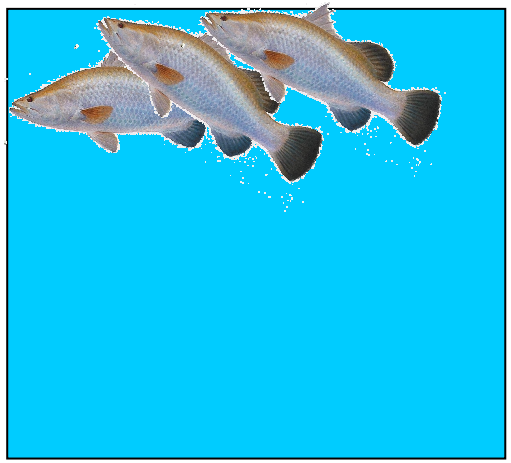
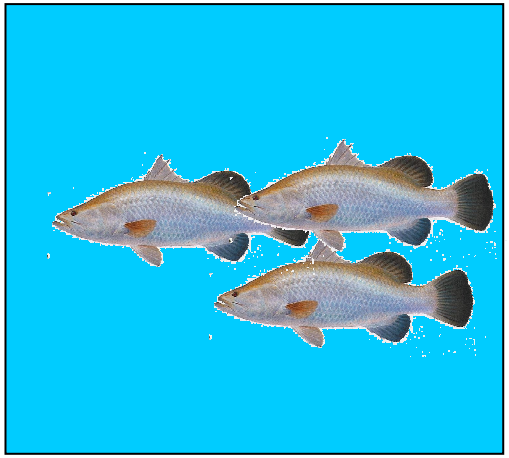
Behaviour



Active

2



Non-responsive

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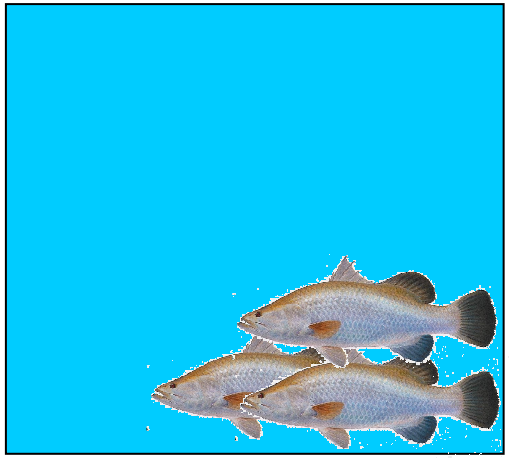

Cryptic

0

Scoring of behaviour to the presence of a person holding their hand over the tank

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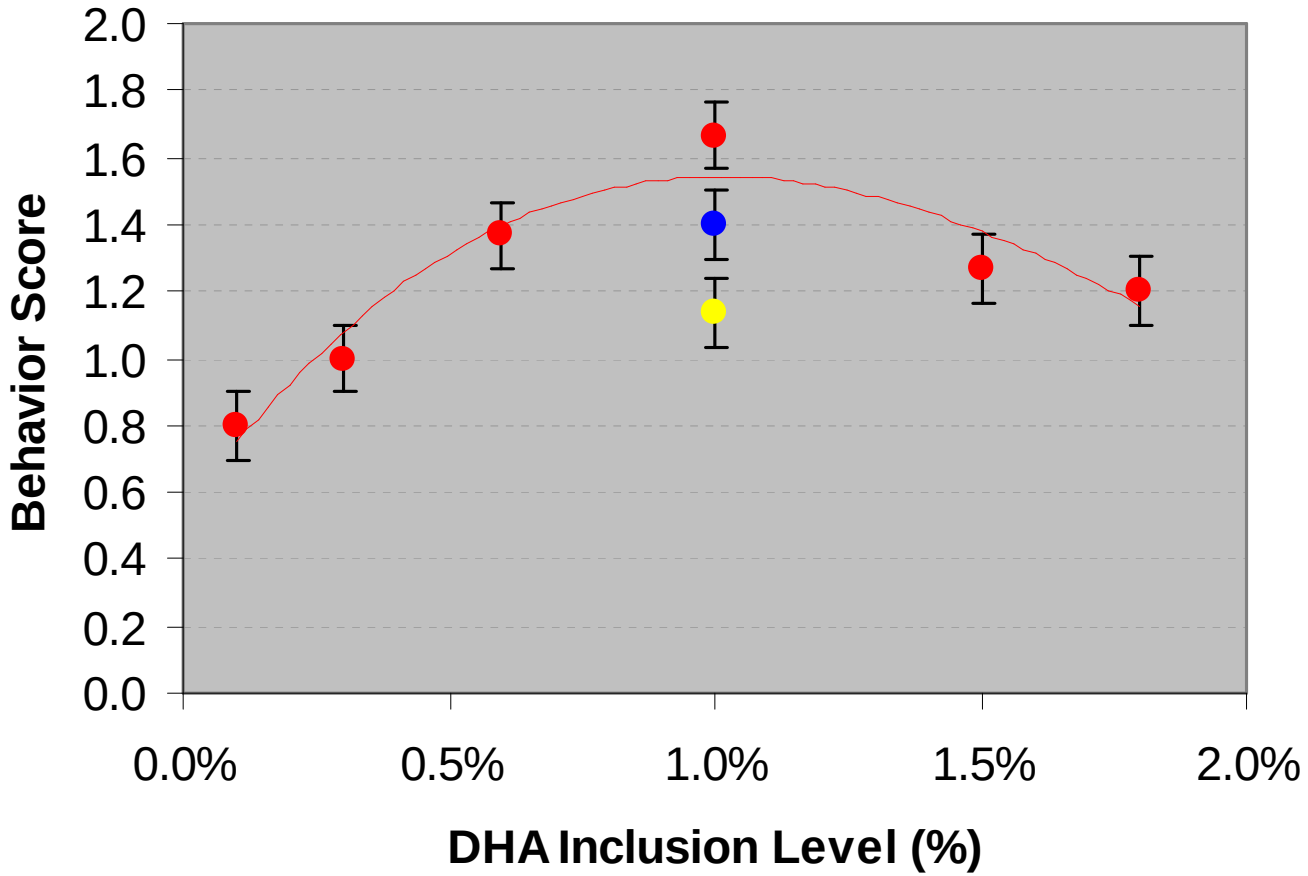
Results - Behaviour

- 1% DHA + 1% EPA
- 1% DHA + 1% ARA
- DHA only



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Subcutaneous haemorrhaging

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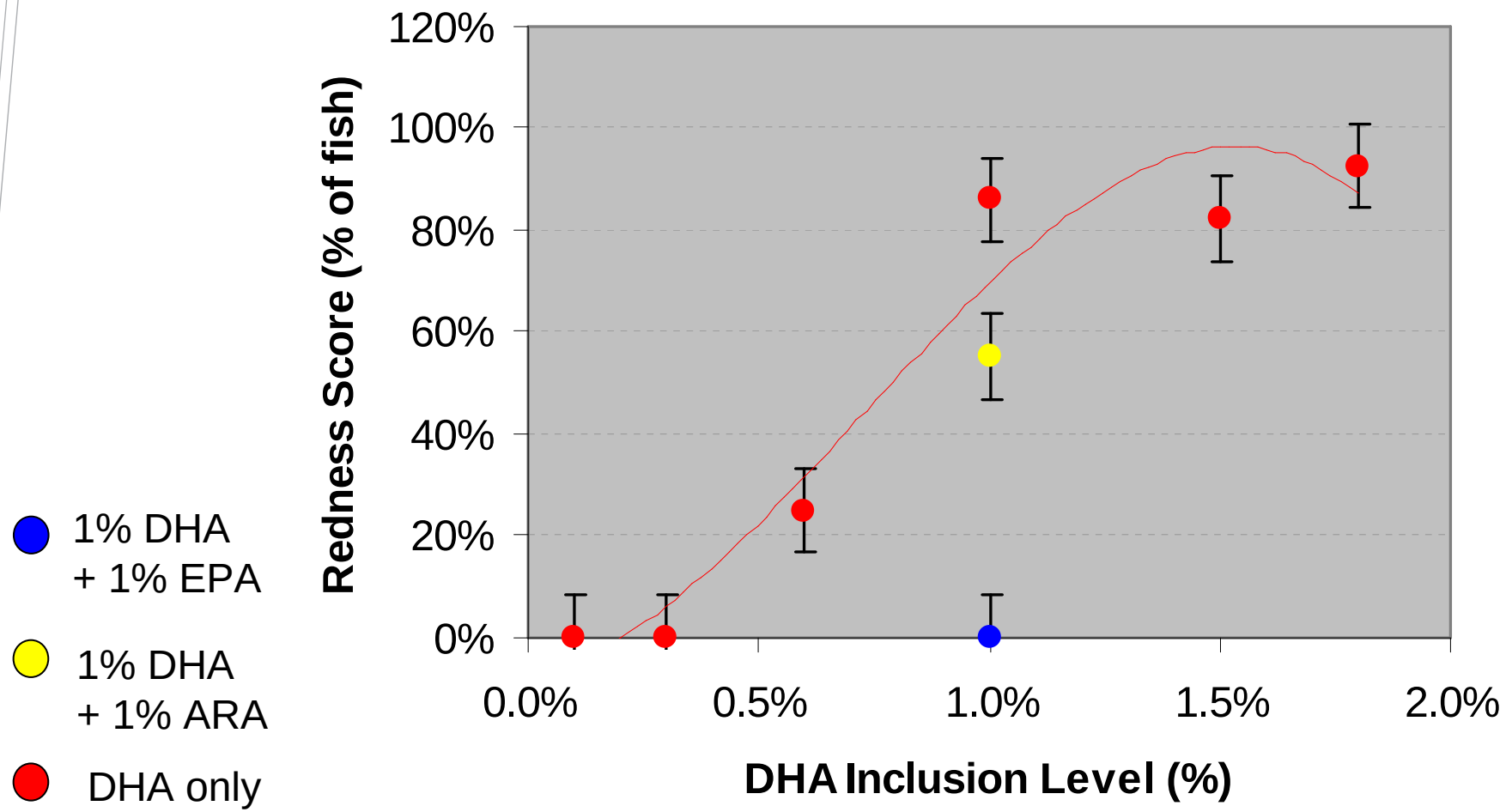
Results - “Redness” Score



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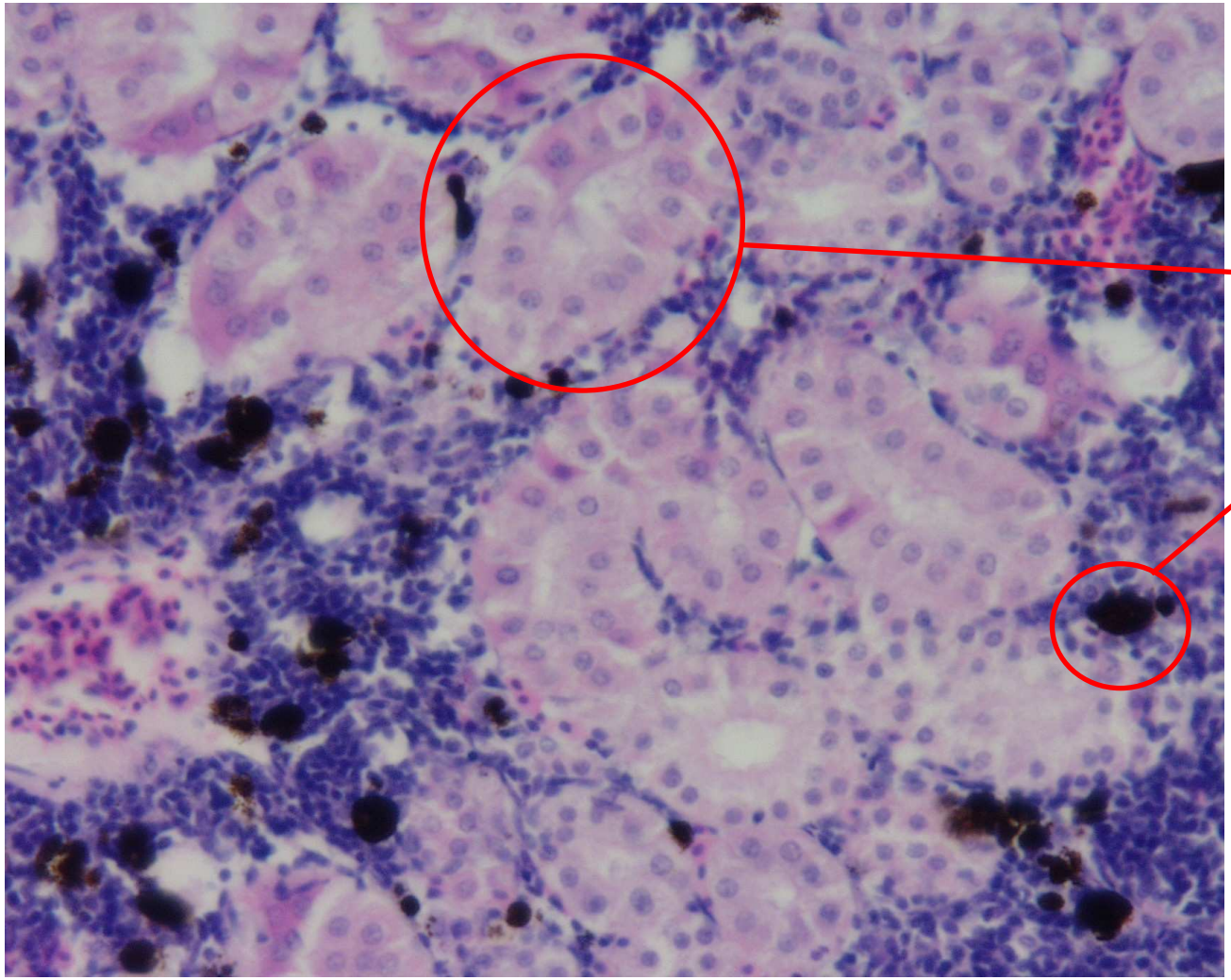
Kidney MelanoMacrophage Centres



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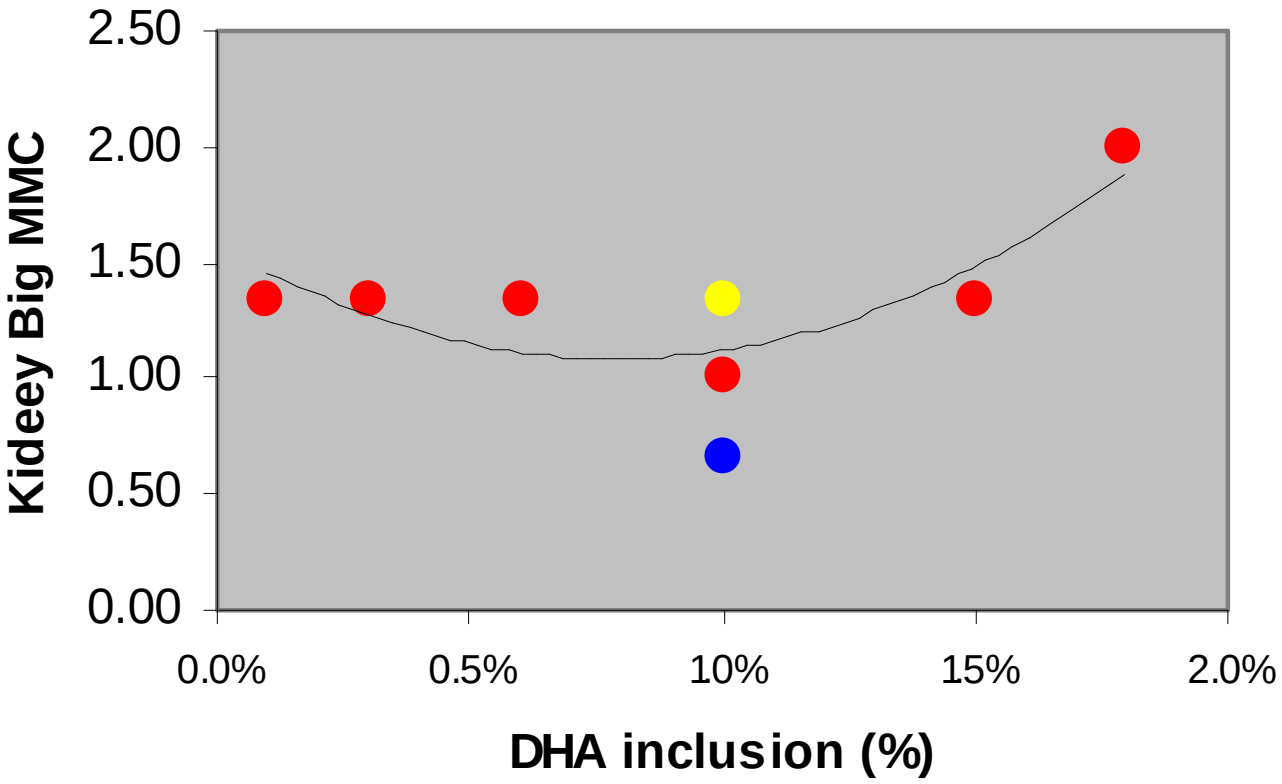
Results - Kidney MMC scores

- 1% DHA + 1% EPA
- 1% DHA + 1% ARA
- DHA only



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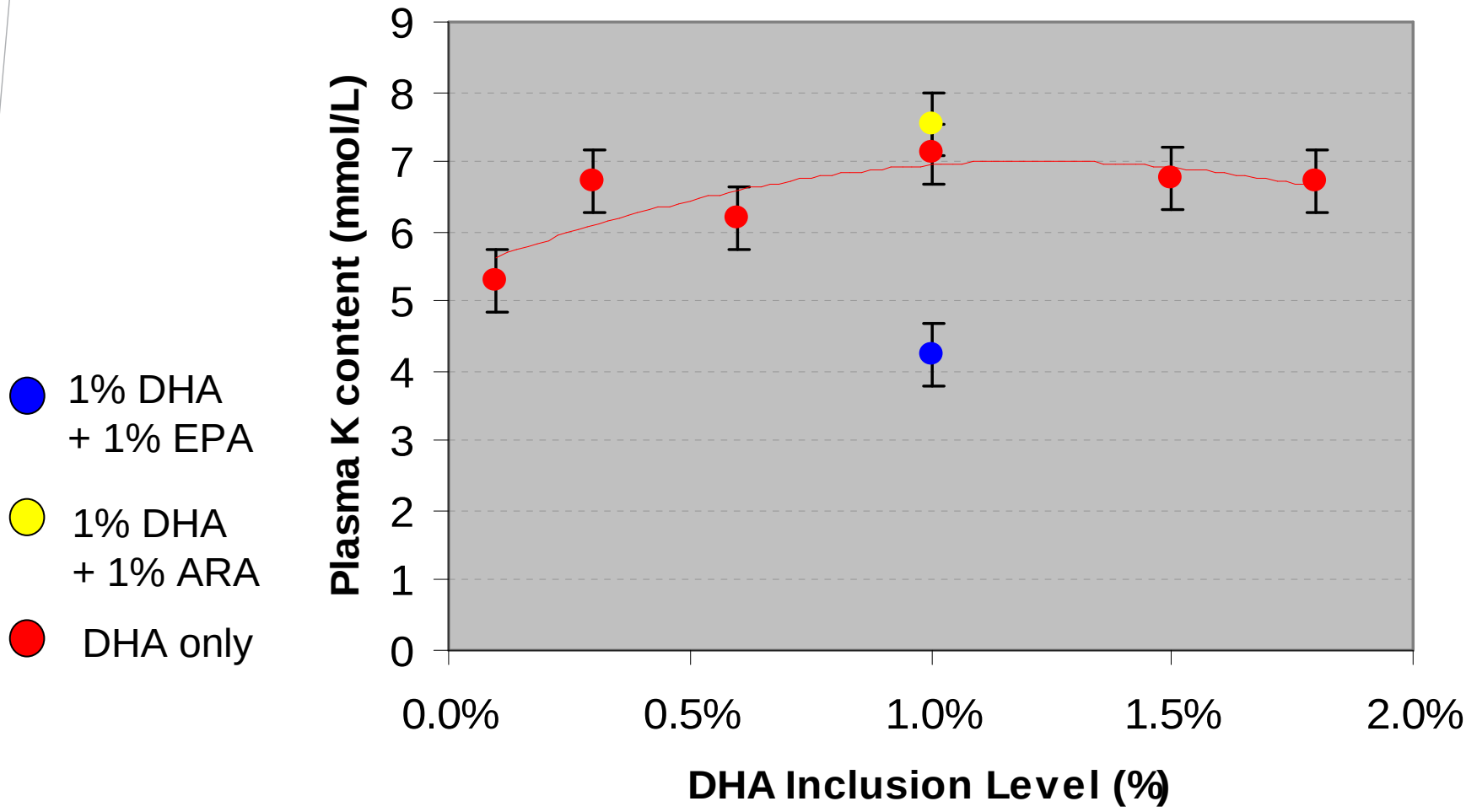
Results - Plasma K balance



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DHA Effects Summary

- DHA has limited direct effect on growth
- DHA has a major effect on behavioural responses
- DHA in the absence of EPA causes significant ionic regulatory problems
- BOTTOMLINE – DHA needs to be balanced with EPA to manage omega-3 requirements for barramundi

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