

Cetoleic acid makes pelagic fish more healthy

WORKSHOP IN FISHMEAL AND FISH OIL, NOVEMBER 2018



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Omega-3 fatty acids and health



Eye

Brain

Cell membrane

The marine omega-3 fatty acids EPA and DHA are key components in all cell membranes

- Development of brain
- Visual function

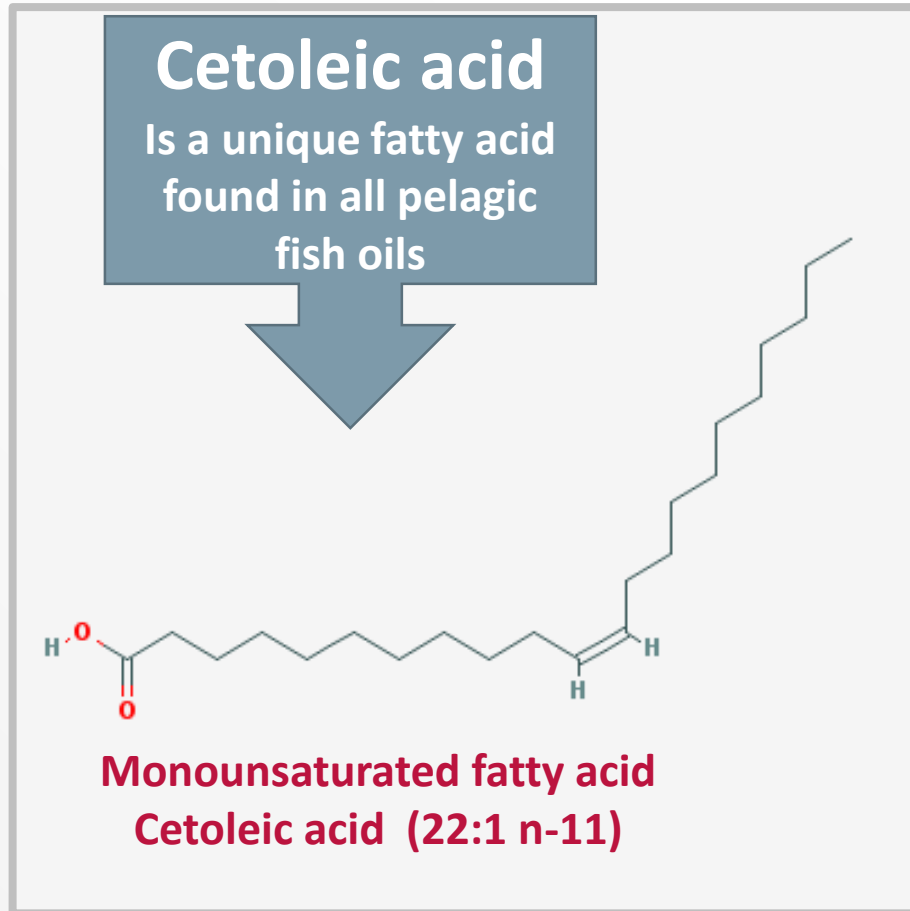
EPA and DHA help to maintain good heart health

- Reduces blood pressure
- Reduces the risk of blood clots

Important for a well functioning immune system

- Anti-inflammatory effect

The question asked, what is the health impact of cetoleic acid?



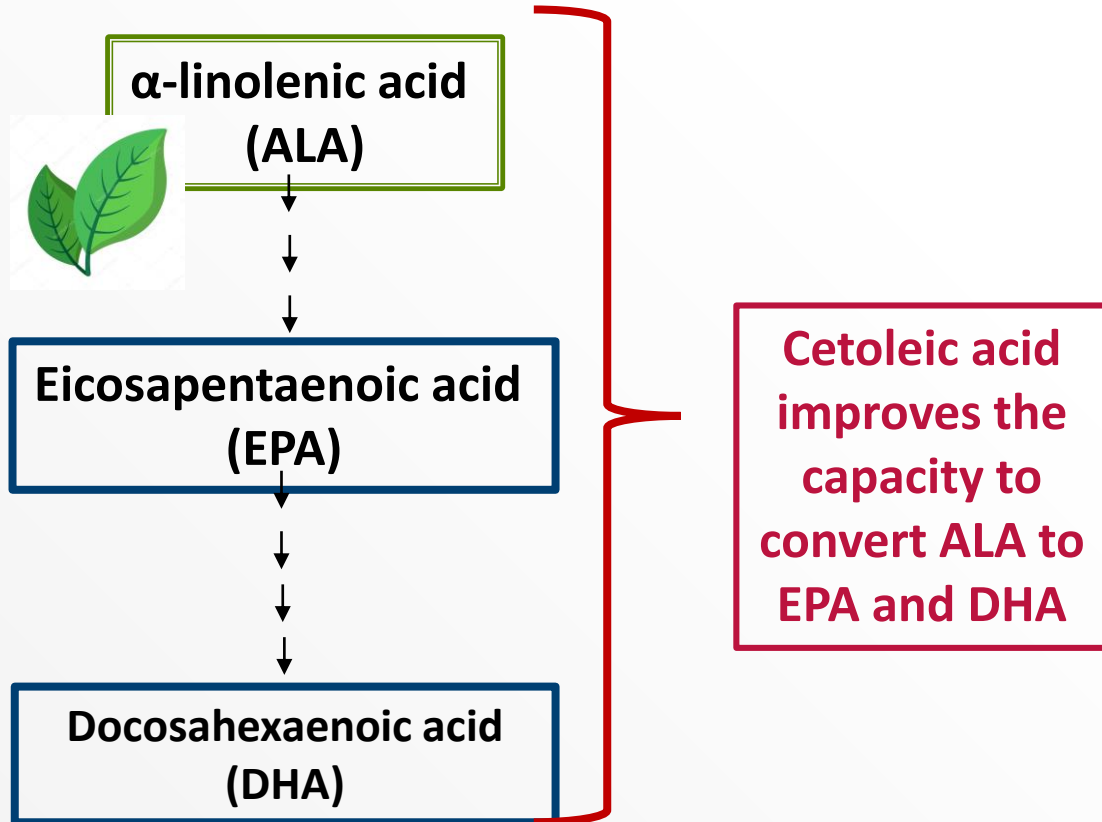
<i>% of total fatty acids</i>	<i>Herring</i>	<i>Capelin</i>	<i>Sardine</i>	<i>Anchovy</i>
EPA	3.9-15.2	6.1-8.0	16.2	7.6-22.0
DHA	2.0-7.8	3.7-6.0	3.3	9.0-12.7
Cetoleic acid	6.9-30.6	15.4	1.0	1.0-2.1

Hypothesis by Opstvedt in 1997

Opstvedt J (1997) Fish lipids: more than n-3 fatty acids? Med Hypotheses 48, 481-483.

Humans have the ability to make EPA and DHA from plant omega-3 (ALA), but the capacity is limited

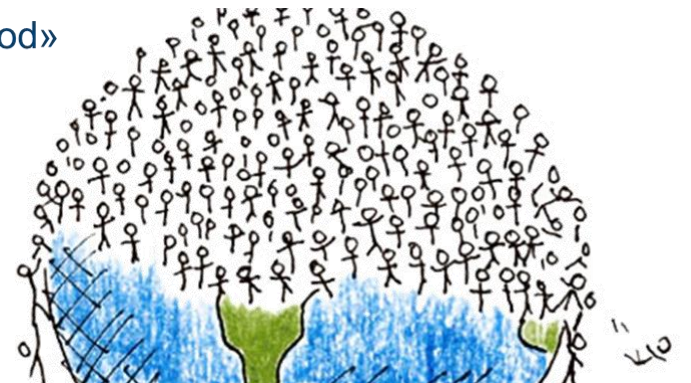
Hypothesis never previously tested



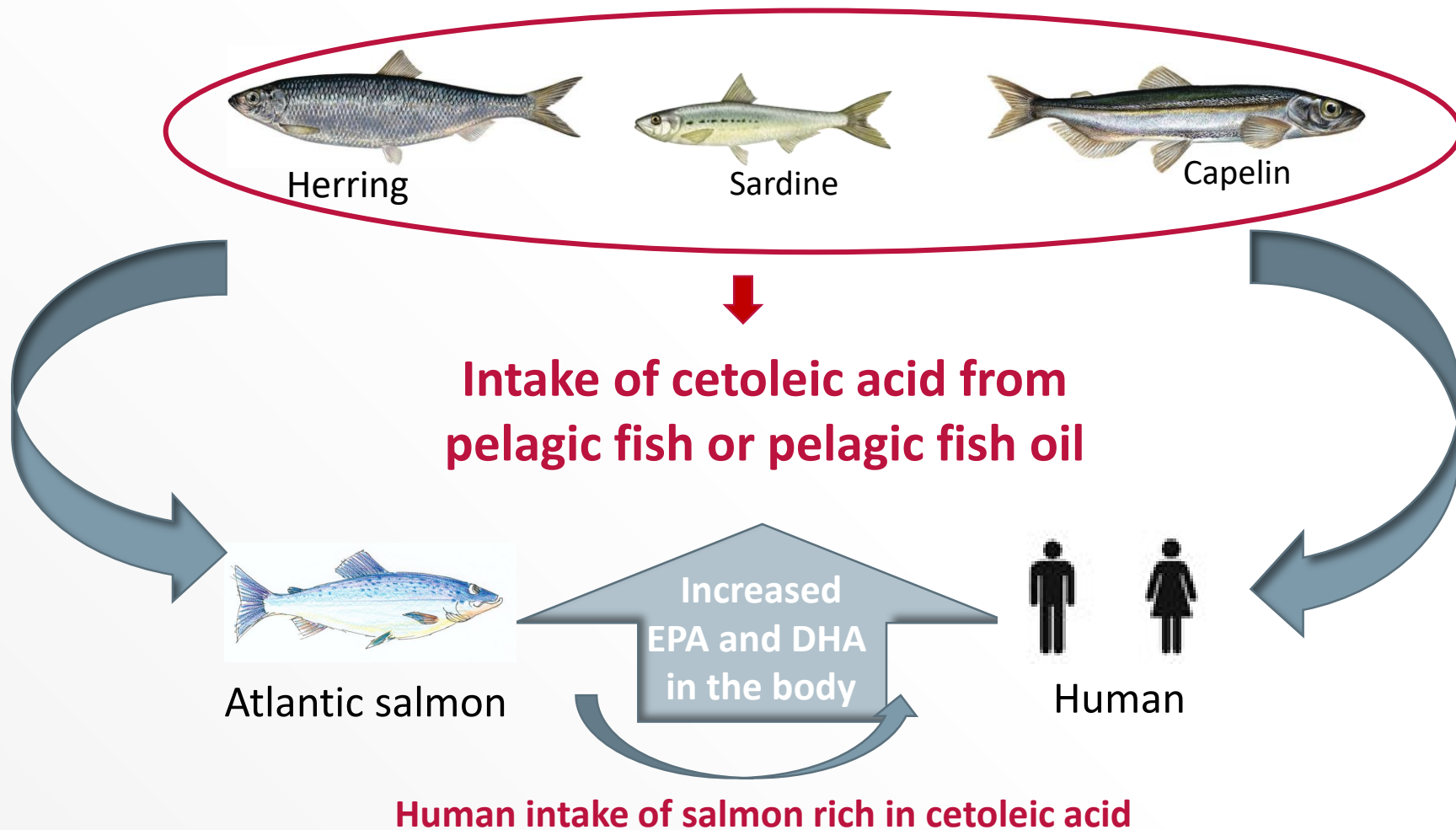
Why is this important to test?

- EPA and DHA are essential components in our diet
- World population projected to reach 9.7 billion by 2050 (UN)
- Not enough marine ingredients to cover the need for EPA and DHA in a growing population

«Secure-feed-to-secure-food»
(Miladinovic, 2017)



The aim is to increase the ability to produce EPA and DHA in humans and salmon by intake of pelagic fish or fish oils



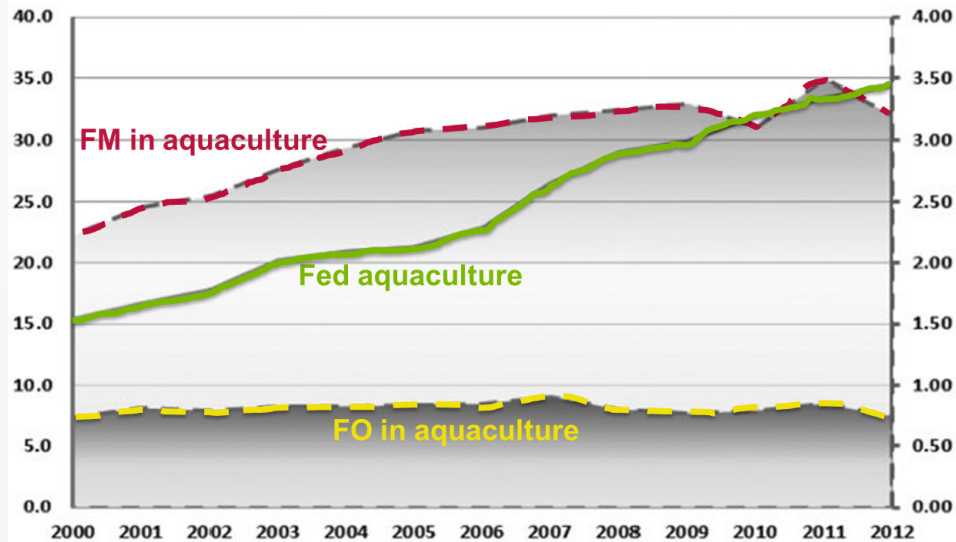
Factors Driving the Change in use of ingredients in Aquaculture feed



Marine Ingredients
- Stable production

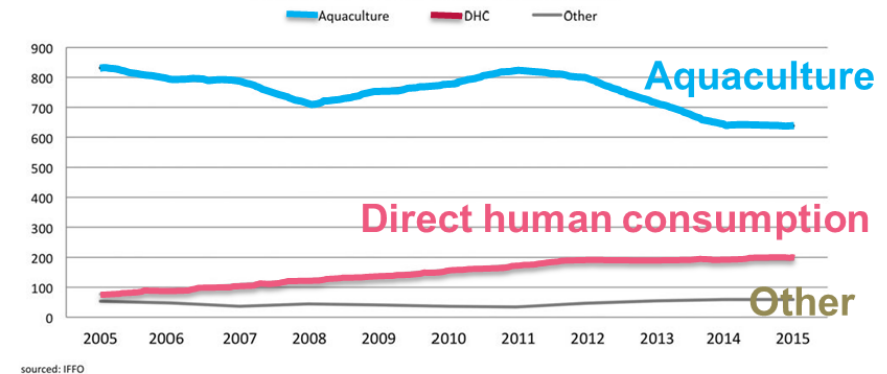
Aquaculture
- ↑ production (5,8% annual growth, IFFO 2014)

Global Aquaculture Production with fishmeal and fish oil usage 2000-2012 tonnes millions



Gap between demand and supply

Trends of Use for Fish Oil ('000 mt)

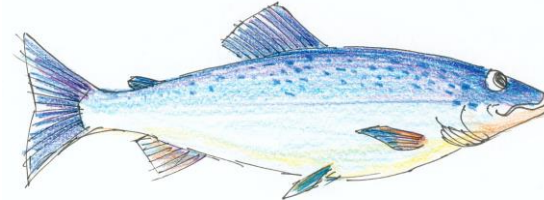


sourced: IFFO

(Shepherd et al., 2017)

Pelagic fish as an ingredient in salmon diet;

A tool to optimise utilisation of available fish oils and further to secure a healthy fatty acid composition of salmon muscle?



Dietary fatty acids

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fillet fatty acids

Today salmon feed consist of 70% plant ingredients and 30% marine ingredients, which has led to a 2 fold reduction in EPA + DHA content of fillet in recent years



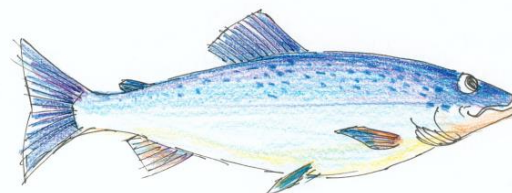
Factors leading to increased capacity to deposit more EPA and DHA relative to what is given in the feed is of high value

Testing of hypothesis in different model systems

- **Cell models**
 - Human liver cell line
 - Salmon liver cells



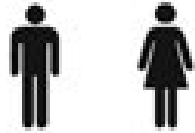
- **Feeding trials with salmon**



- **Feeding trial with rats**

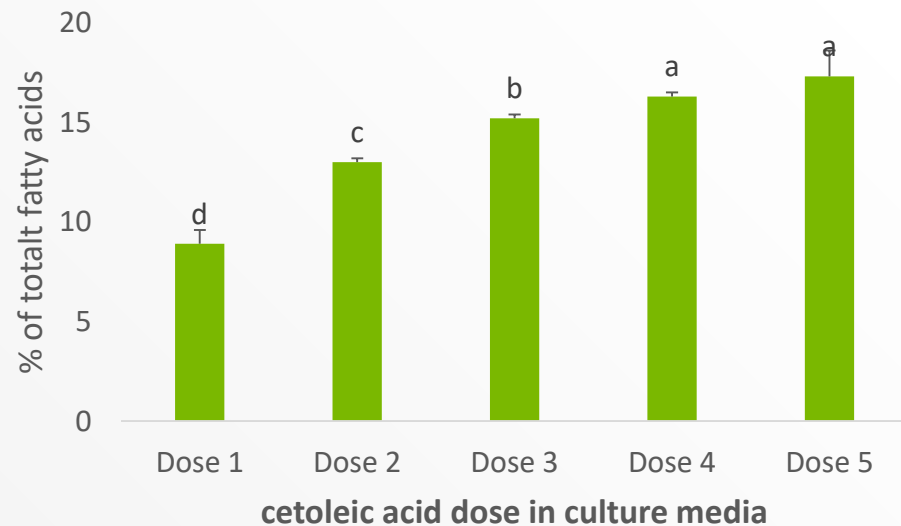


Cetoleic acid increases the production of EPA and DHA in human liver cells and salmon liver cells

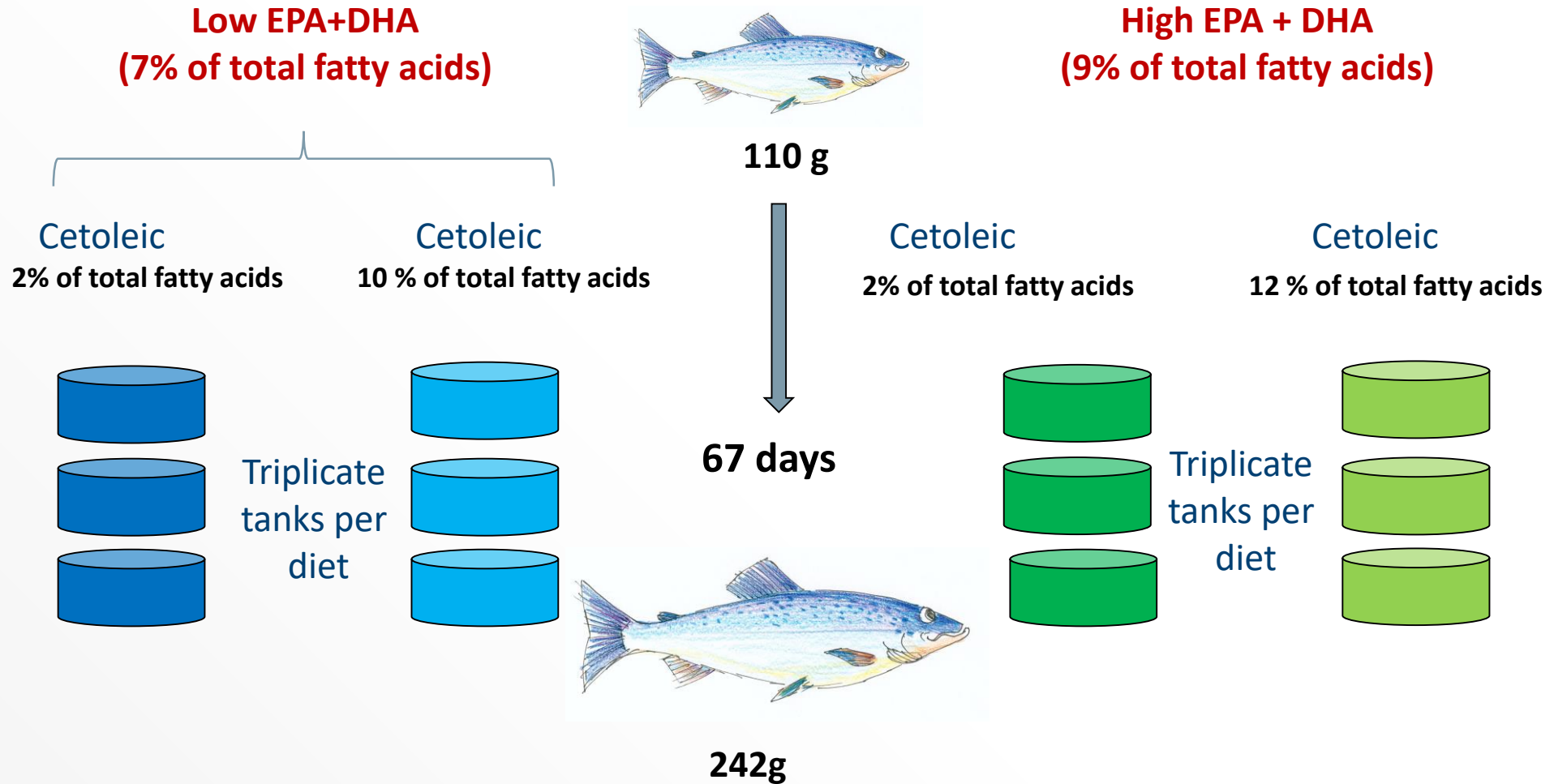


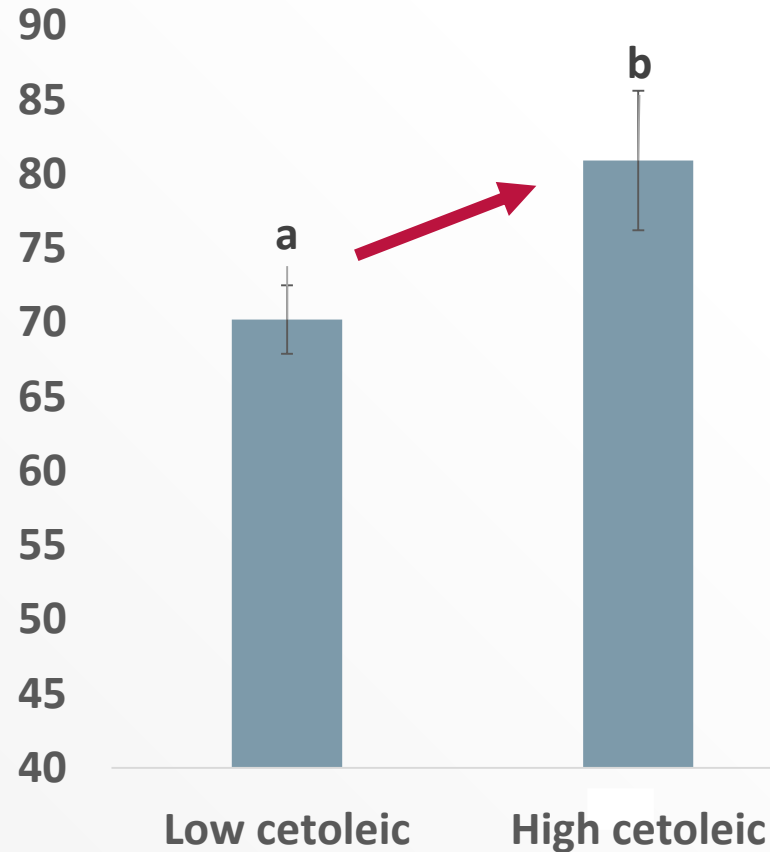
Liver cells
DHA production

■ DHA



Atlantic salmon were fed diets supplemented with high and low levels of pelagic fish oils

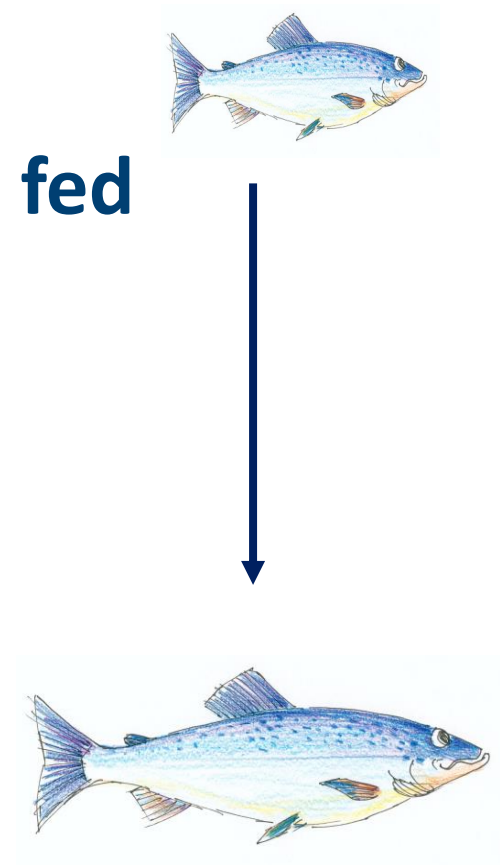




Result:

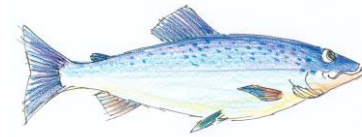
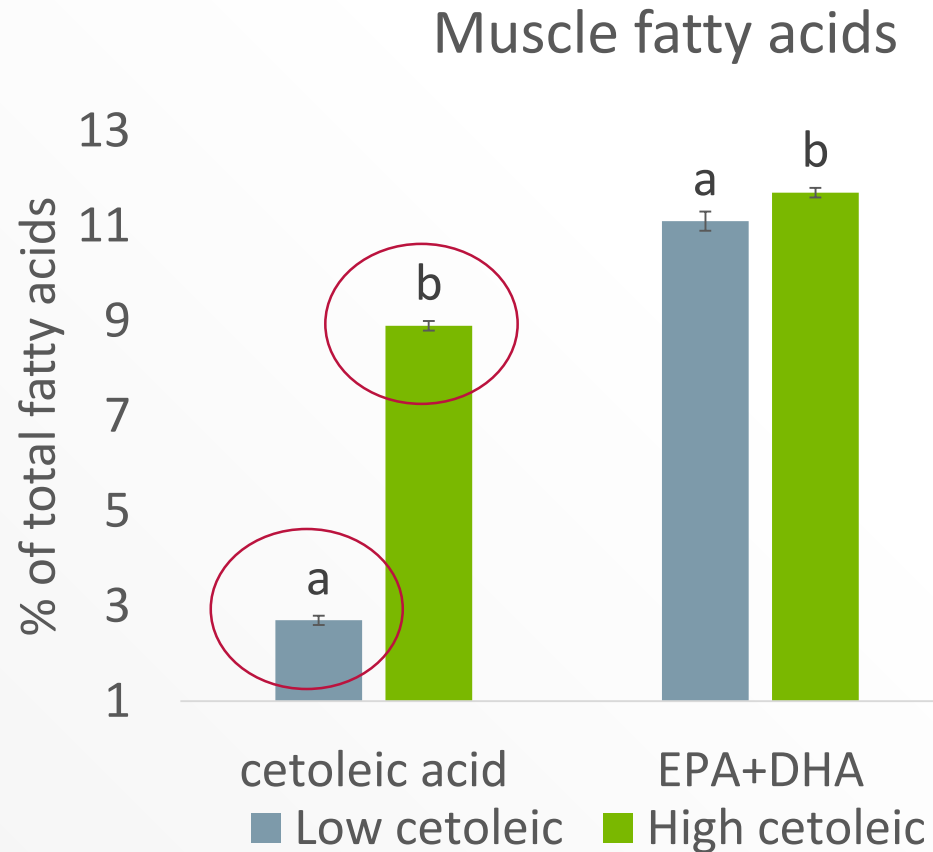
10% higher retention of EPA + DHA in whole body of salmon fed a diet rich in cetoleic acid compared to a diet low in cetoleic acid

The level of EPA + DHA in the diets was the same



The cetoleic acid content of diet influence cetoleic acid content of muscle

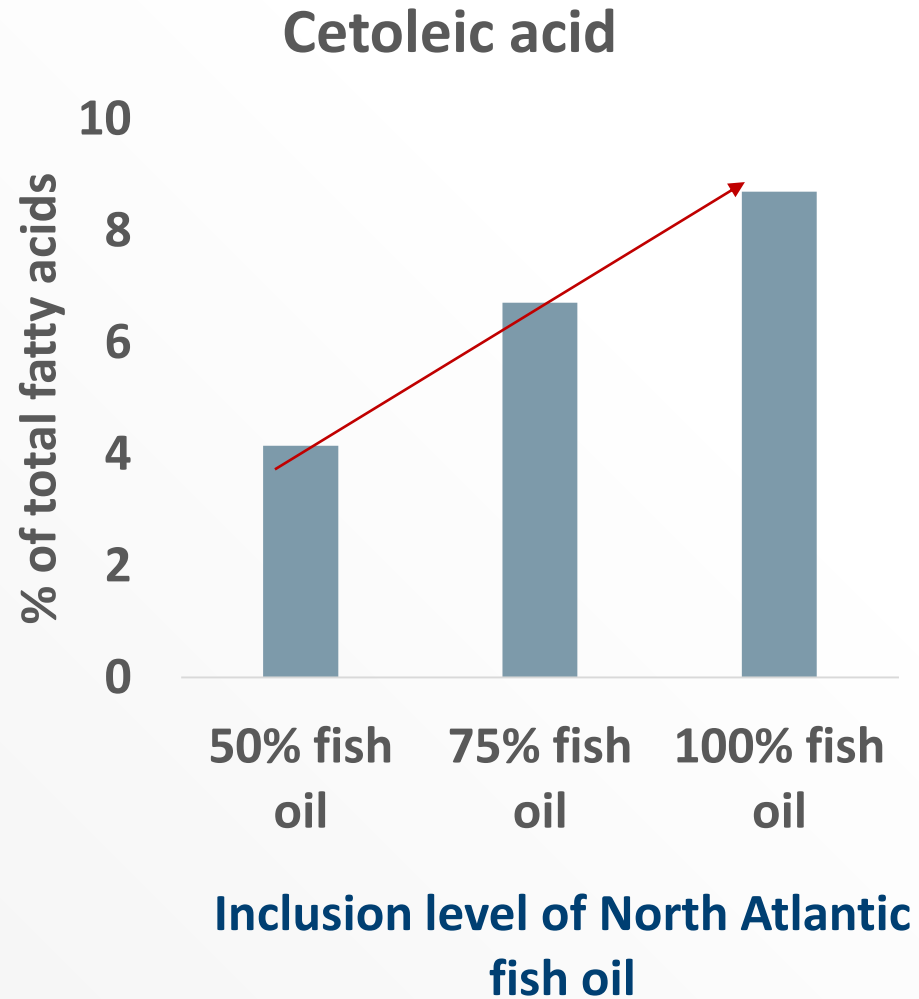
Positive for human consumption?



Does intake of salmon rich in cetoleic acid give health benefits in humans?

Rats were fed diets 3 levels of cetoleic acid in diet for 6 weeks

Model for humans



Results shows that cetoleic acid in the diet increase the production of EPA, DPA and DHA in rat

EPA and DHA are negatively correlated with ALA and positively correlated with cetoleic acid in feed

	EPA In blood cells	DHA In blood cells
ALA in feed	-0.428 (0.010)	-0.315 (0.065)
Cetoleic acid in feed	0.931 (<.0001)	0.882 (<.0001)

Summary

Human models

- Cetoleic acid **increase the production of EPA and DHA**, from the precursor ALA, in human liver cells.
- Cetoleic acid combined with the precursor ALA in diets of rats **increase the level of EPA and DHA in red blood cells**

Atlantic salmon

- Cetoleic acid **increase the production of EPA and DHA** in salmon liver cells
- Cetoleic acid is an **important ingredient** in salmon feed; it gives 10% increase in deposition of EPA+DHA in whole body relative to what is given in the diet *(two independent feeding trials).*

Cetoleic acid makes pelagic fish even more healthy



Thank you for the attention

Funded by FHF and NRC

