

Calanus finmarchicus

A pre-eminent source of novel marine
ingredients

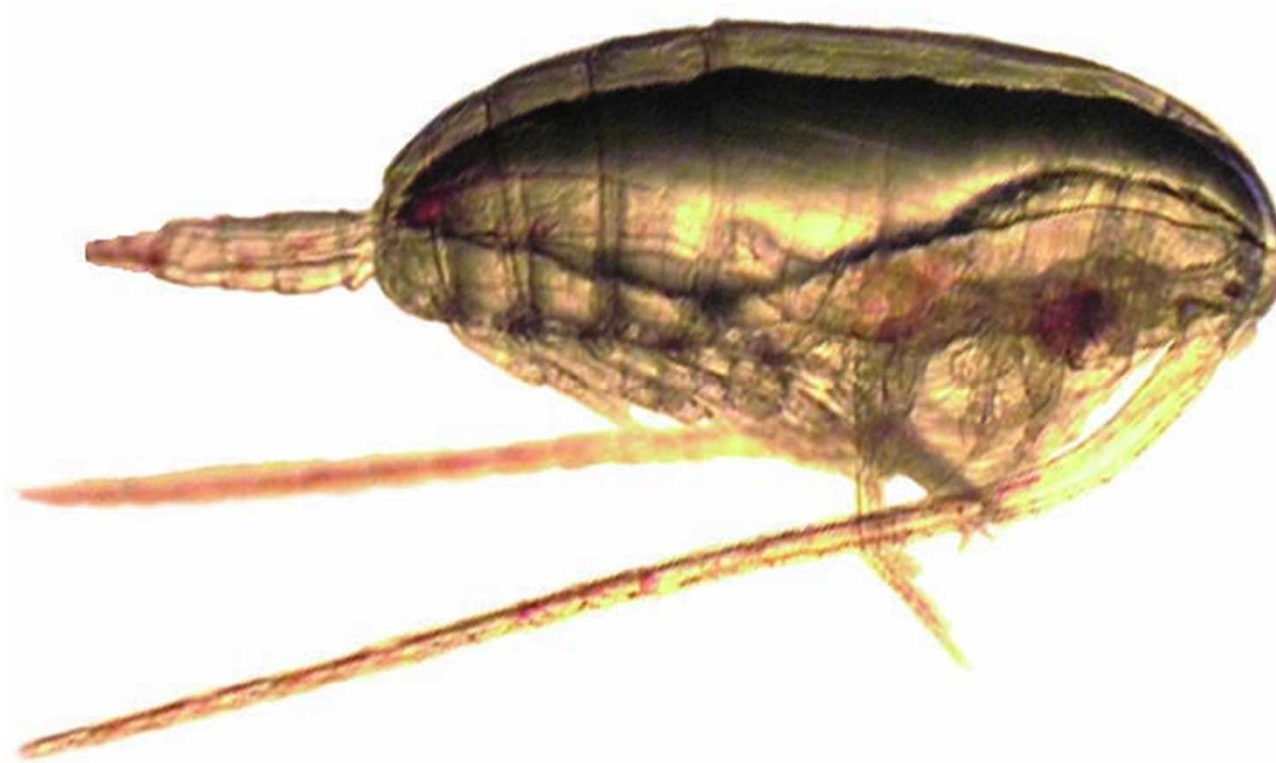
Jan Raa

Prof. *emeritus*

(Board member of Calanus AS)

Calanus finmarchicus

Tiny (3-4 mm) marine copepod (zooplankton)



Calanus finmarchicus

Not krill!

Highly different in

- size
- genetics/biology/ecology
- chemical composition



Calanus finmarchicus

Largest zoological biomass in North Atlantic

- Feeds on phytoplankton - only
- Produces 200-400 million tons of biomass every summer

(= 10-20 x the total aggregated biomass of fish, shrimp, whales and sea birds in the same ecosystem)
- The source of PUFAs in fish, sea-mammals and sea-birds

Scooping of *Calanus finmarchicus* swarming in sea-surface

Insignificant by-catch and low energy-usage (= sustainable harvesting technology)



- *Calanus finmarchicus*
pumped into containers on
board, drained – and...



- frozen in blocks and processed ashore



Separation of oil and wet biomass (no organic solvents!)

Alternatives

- 1) Oil (yield 90-95 %) + wet biomass (~ 10 % lipid of dry weight)
- 2) Oil (yield > 98 %) + wet biomass (< 1 % lipid of dry)

Products of separation Alternative 1

Powder (~10 % lipid)



Calanus Oil



Composition of *Calanus* Oil

(as in live *Calanus finmarchicus*)

- Sterols (total): ~5 mg/g
 - **Brassicasterol**: ~ 2.5 mg/g
- Astaxanthin (-ester): > 1000 ug/g
- **Monoesters**: ~ 800-850 mg/g
- Triglycerides + phospholipids + free fatty acids:
~150 mg/g
 - Fatty acids (Ratio n-3/n6 > 20)
 - SDA (C18:4n3)**: > 70mg/g
 - EPA (C20:5n3)**: > 50 mg/g
 - DHA (C22:6n3)**: > 40 mg/g
 - **Fatty alcohols**
 - C20:1n9** : ~ 140 mg/g
 - C22:1n11**: ~ 220 mg/g

Safety and tolerability in humans

Study report 2010 (University Hospital of Northern Norway, Tromsø)

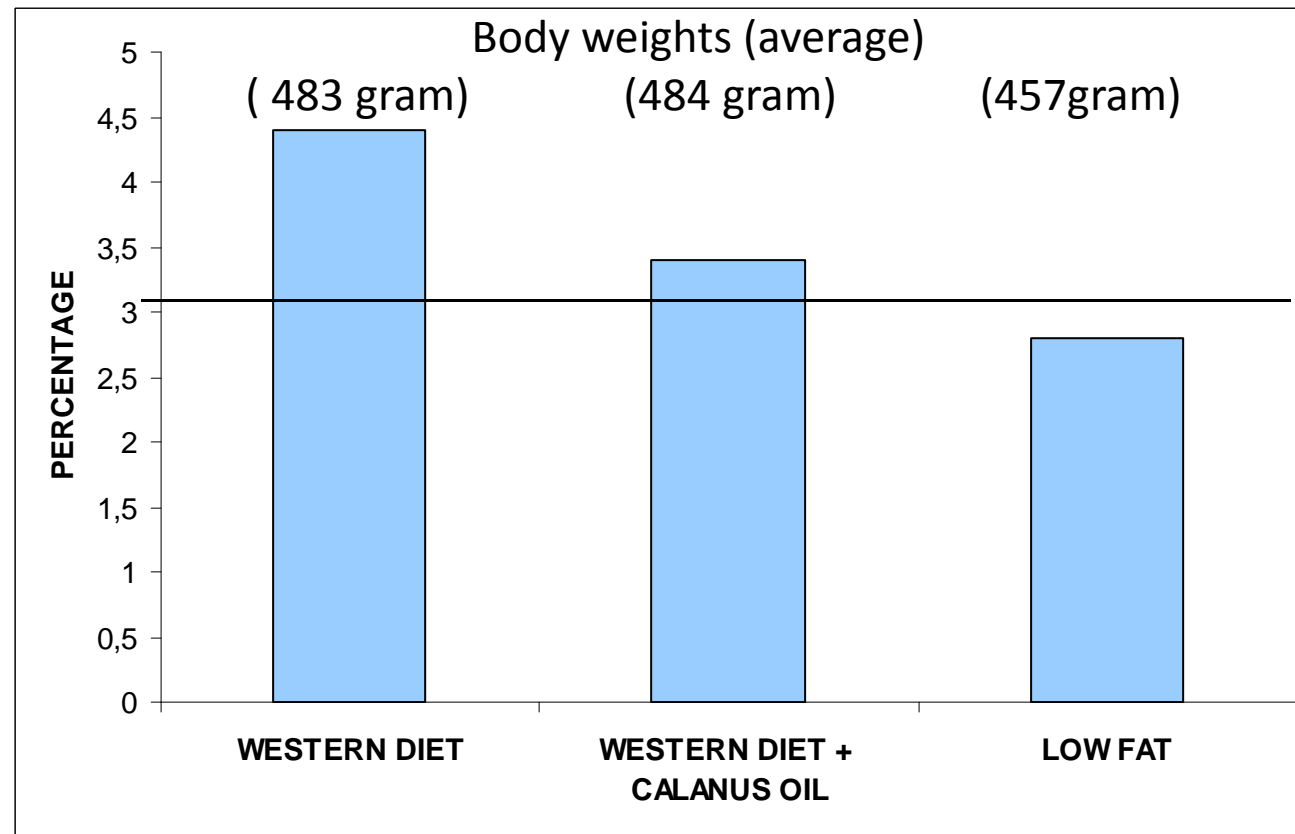
“In conclusion, Calanus Oil in the doses given appears to be safe and well tolerated”

(Doses: 1, 2 and 4 grams/day)

"Effects of oil from *Calanus finmarchicus* (*Calanus* Oil) in human subjects. A pilot study"

Calanus Oil results in reduced visceral fat deposition

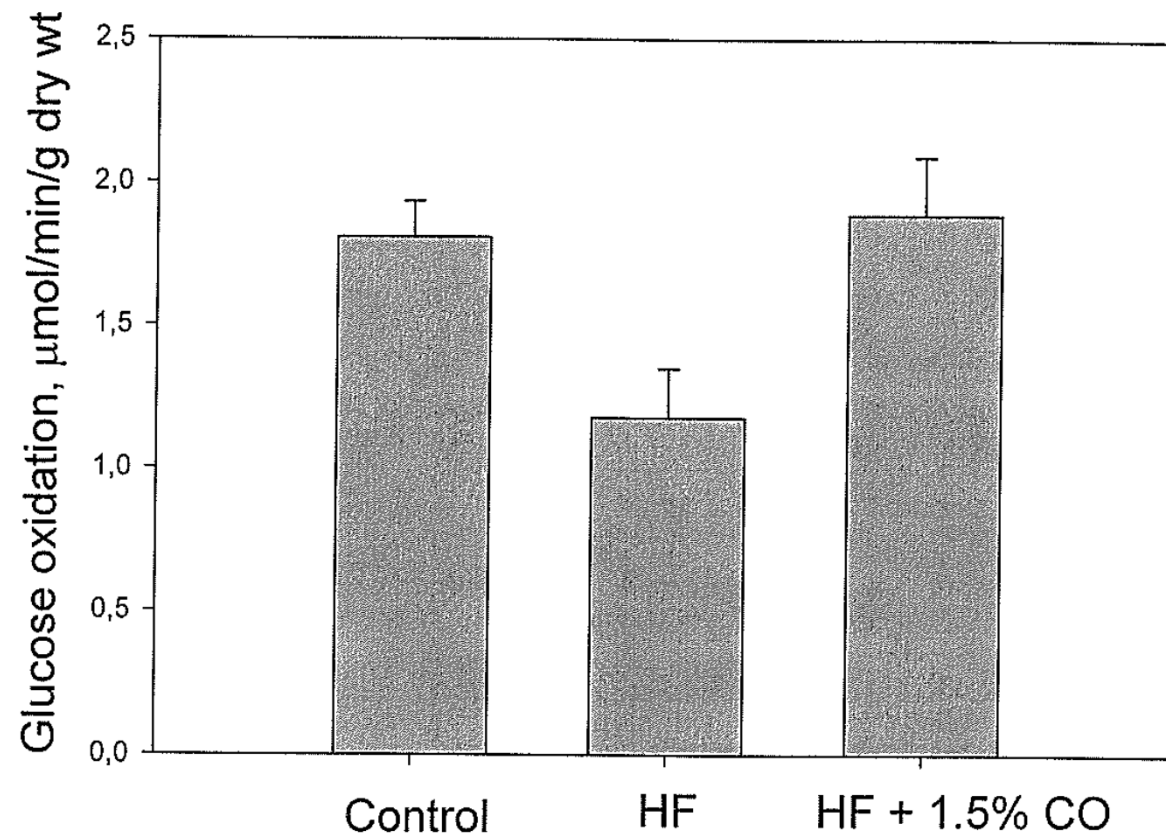
(Wistar rats fed "Western diet" (20 % lard) +/- 1.5 % *Calanus* Oil for 110 days)



Calanus Oil counteracts loss of cardiac function

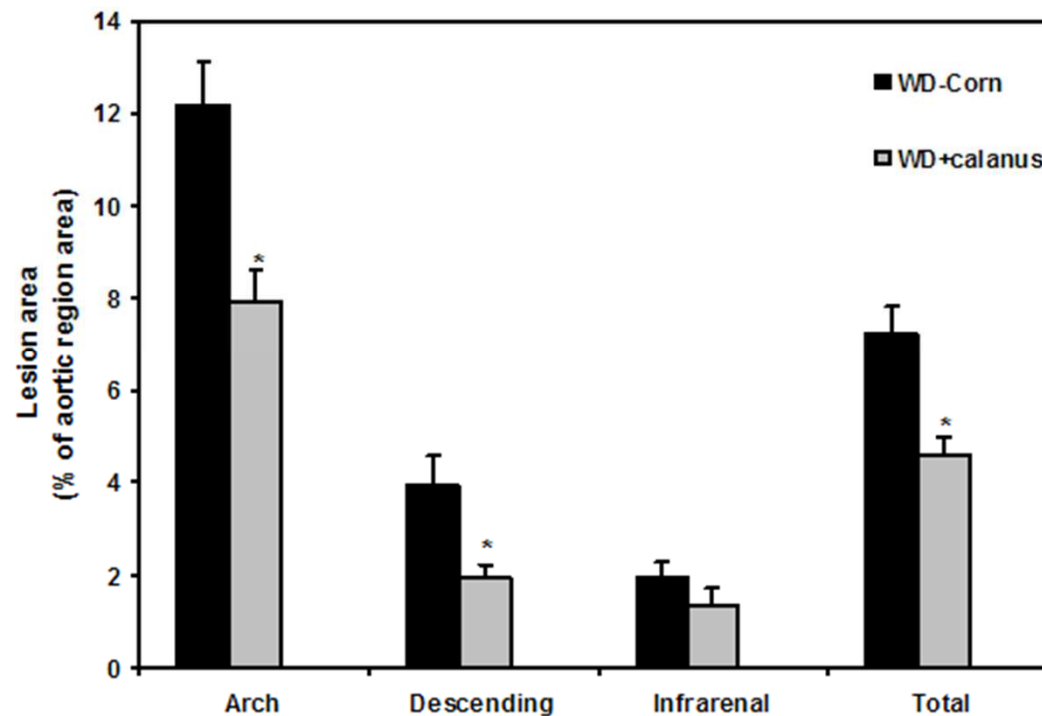
(Glucose oxidation capacity of heart muscle of Wistar rats fed for 110 days on a high-fat (20 % lard) "Western" diet +/- 1.5 % *Calanus* Oil)

Glucose oxidation



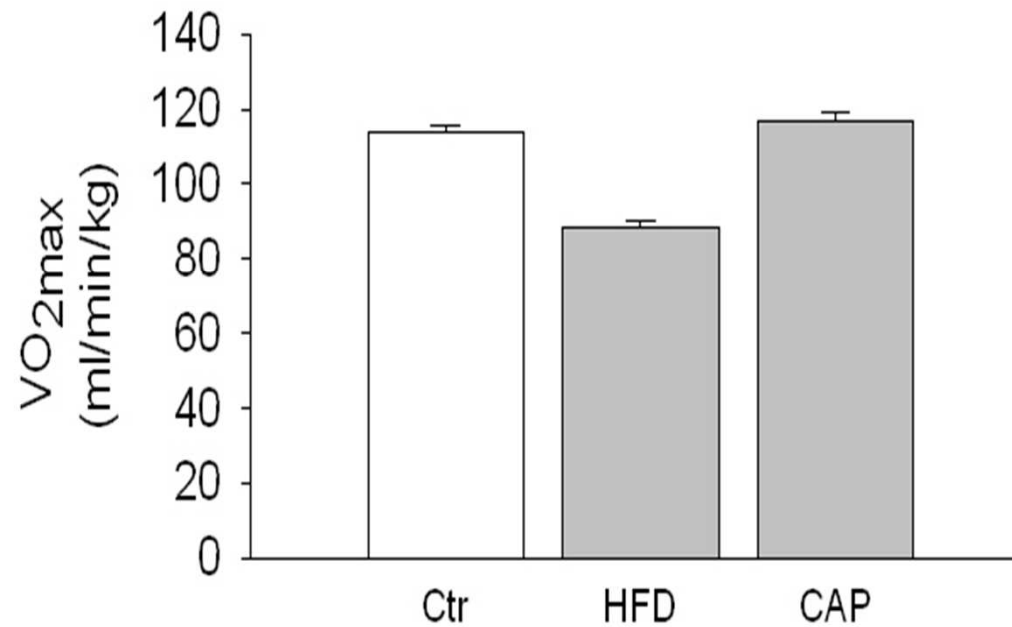
Calanus Oil reduces arterial plaque formation

(ApoE-deficient mice were fed for 13 weeks on a diet high in fat (22 % milk fat), cholesterol and carbohydrate (38 % sucrose and starch diet) +/- 1 % *Calanus* Oil)



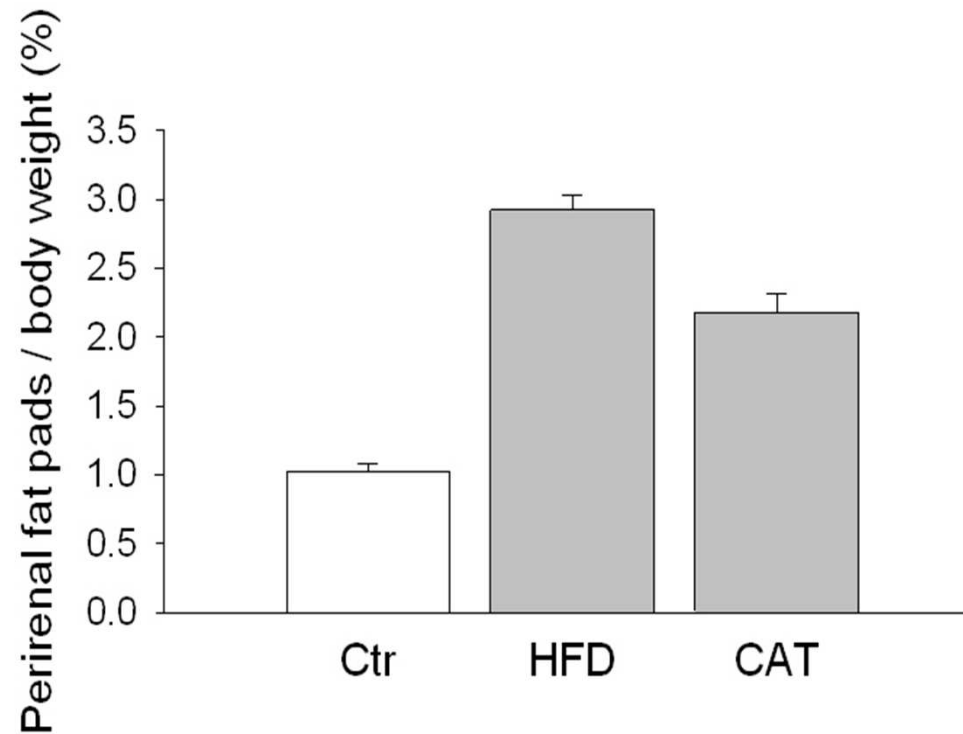
Calanus Oil maintains exercise capability

(Maximum oxygen uptake of mice that had been fed high-fat diabetogenic diet (HFD) for 27 weeks)



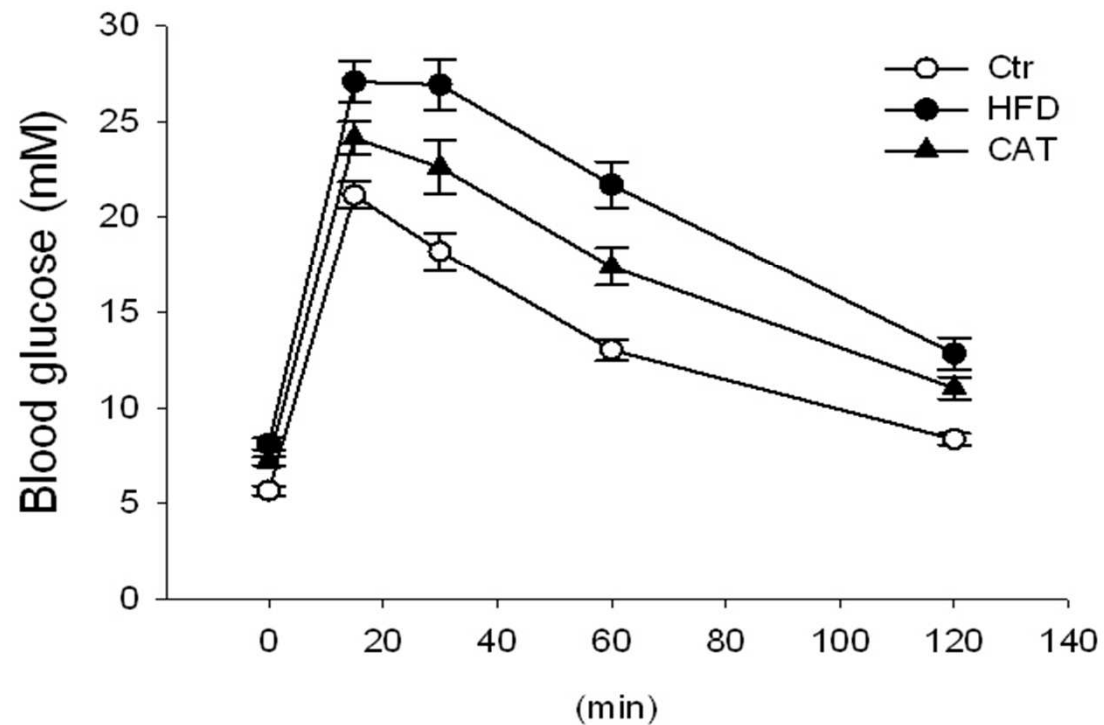
Therapeutic effects of Calanus Oil?

(Visceral fat of mice (% of body weight) after 27 weeks of feeding on a high-fat diabetogenic diet (HFD) and +/- 1.5 % *Calanus* Oil after week 7)



Glucose tolerance

Mice were fed initially for 7 weeks (until pre-diabetic) on high-fat (HFD) diet and thereafter for 20 weeks on the same diet +/- *Calanus*



Mechanisms of action?

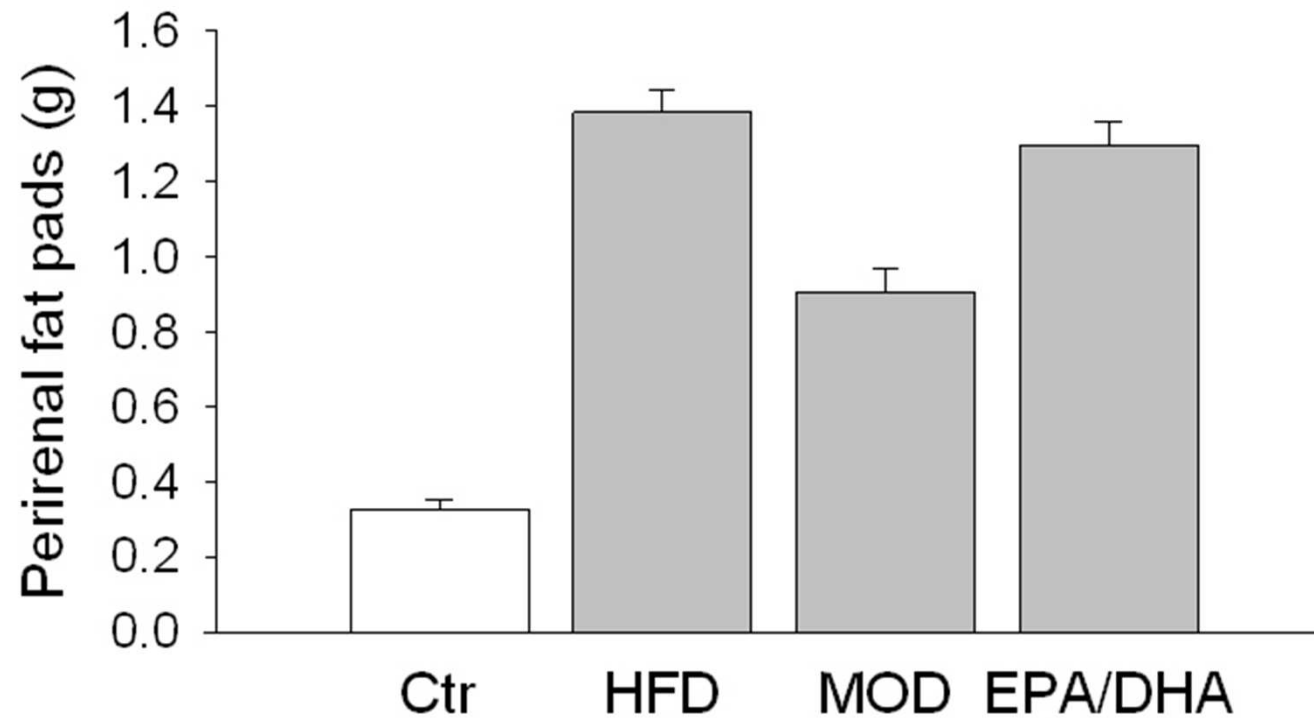
- 1) EPA and DHA?
 - part of the story?
- 2) Other components present in the oil?
 - sterols, astaxanthin, ... NO!

Calanus Oil lowers blood cholesterol in mice

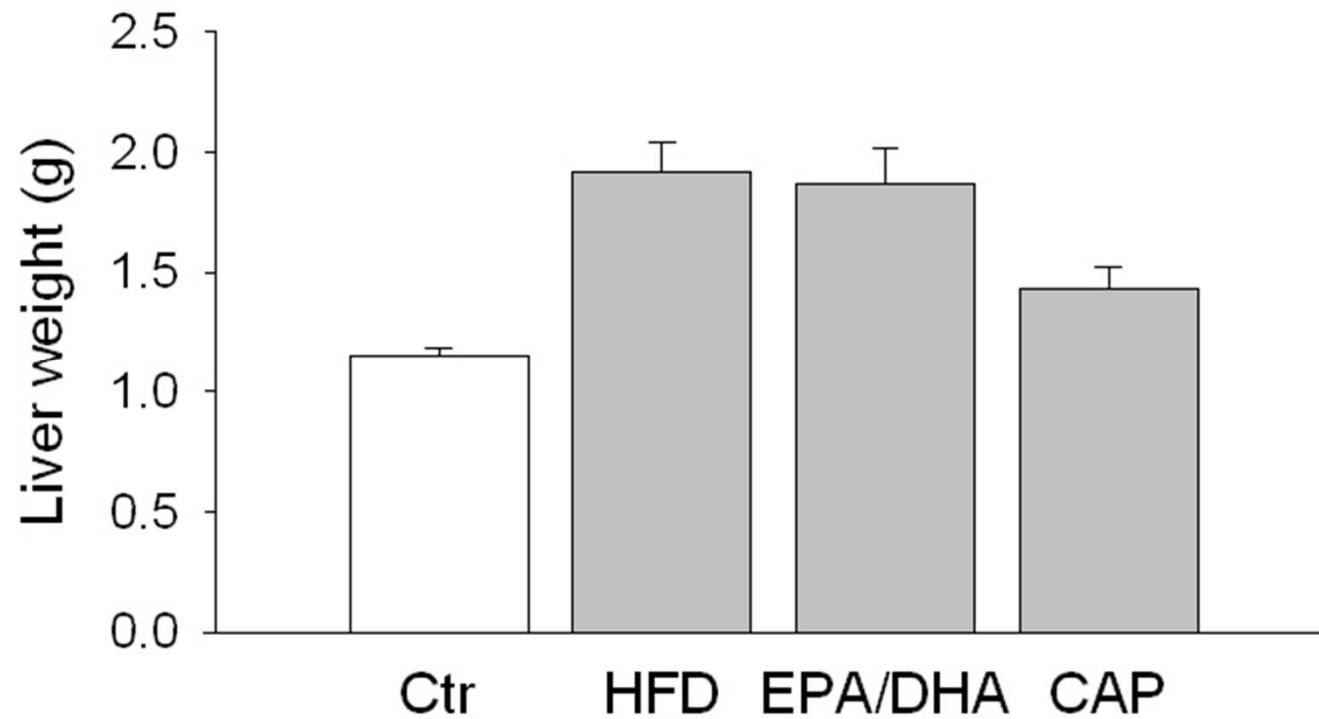
(ApoE-deficient mice were fed a high fat (22 % milk fat) and carbohydrate-rich (38 % sucrose and starch) for 13 weeks)

	Control (n-10)	+ EPA/DHA (n-10)	+ Calanus oil (n-10)
Body Weight (g)	34.6	37.7	38.9
Feed intake (g/d)	2.72	2.72	2.78
Plasma cholesterol (mmol/L)	16.1	15.9	12.3
TGA (mmol/L)	0.96	0.84	0.82

Visceral fat deposition in mice fed EPA/DHA-concentrate in same amount as in *Calanus* Oil

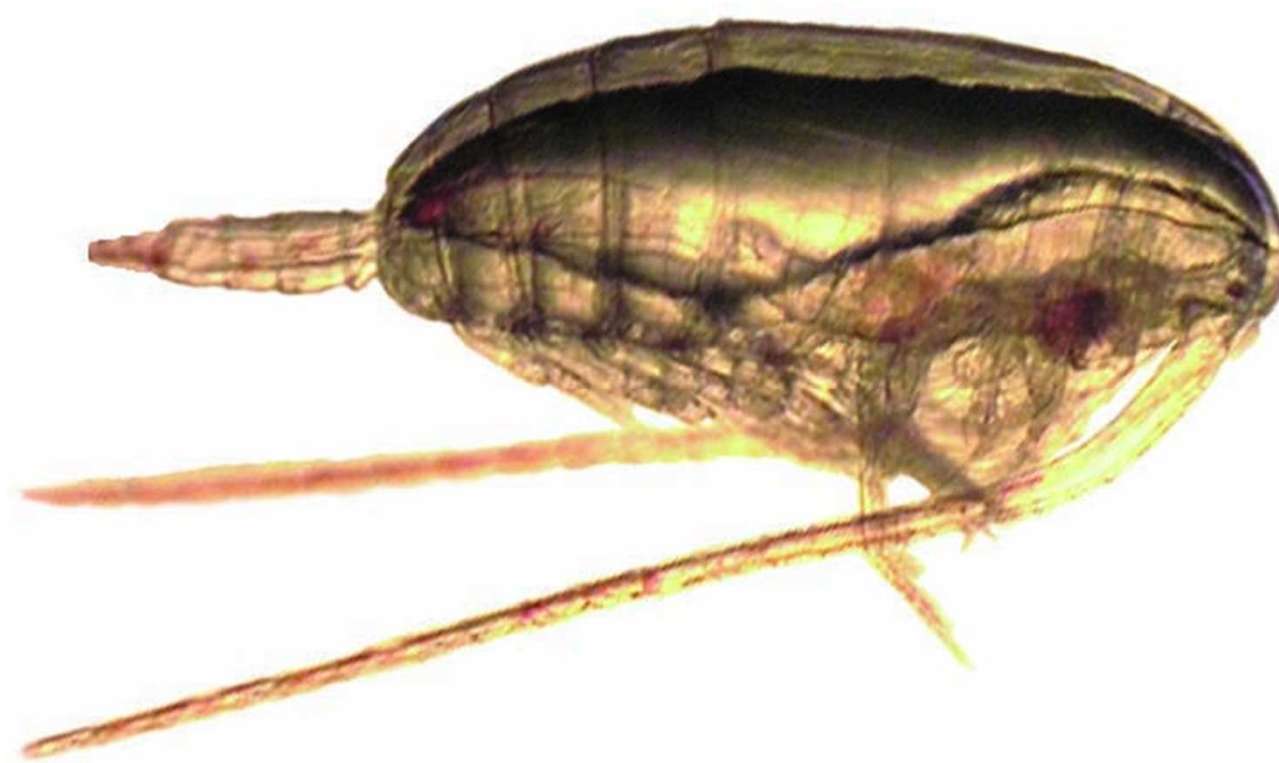


Liver weights of mice fed EPA/DHA-concentrate in same amount as in *Calanus* Oil



Calanus finmarchicus

Food for fish in North Atlantic



Harvesting *Calanus finmarchicus*

Ecological implications?

- Life span: One year
- ~ 10 % of the annual biomass produced utilized by the next trophic level of the food-web
- ~ 90 % settle – in the autumn
- Harvesting where and while swarming in sea-surface
- Insignificant by-catch of fish juveniles
- Harvesting at the lowest possible trophic level

Large scale industrial harvesting – A matter of prudence?

New biomarine industry based on *Calanus finmarchicus*?

- 1) Harvesting 0.01- 0.1 % is sufficient for a noteworthy new industry in Norway –
-- Speciality products of high unit value!
- 2) Harvesting 1% of the biomass produced every summer season would correspond to the total output from the Norwegian fisheries sector –
- - Policy decisions on fisheries bio-economics