



Qardio

SIRKULASJONSFORSTERKER

*Functional feed with krill meal reduce heart pathology
and viral load in heart of Atlantic salmon.*

Gunner Molland, Trygve Sigholt & Ralph Bickerdike

PD TriNation, Dublin, June 3rd 2015

Utilising the krill effect on salmon



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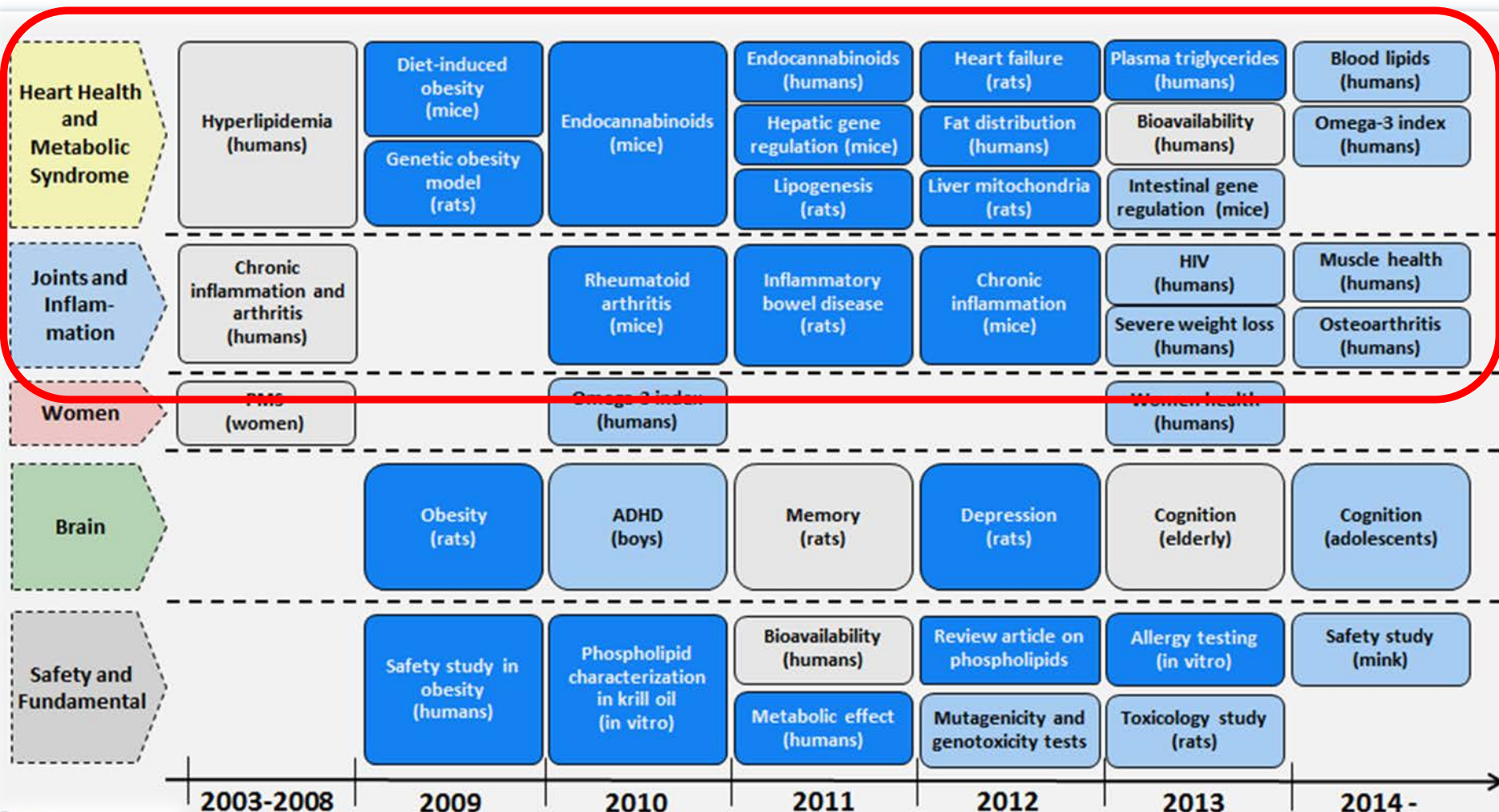
Constituents of krill have been shown to have positive effects on the heart and circulation system in humans and warm blooded animals

Comparable and significant effects seen in other species can be transferred to farmed fish through the use of Qardio



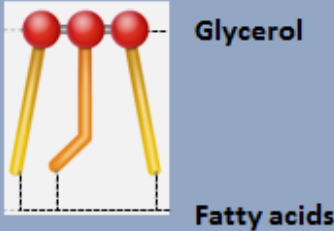
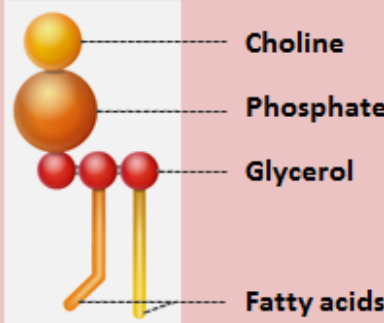

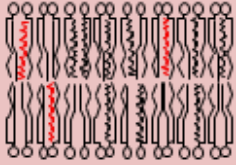
Numerous studies have shown the beneficial effects of krill lipid fractions



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Lipid class comparison

	Triglyceride (fish oils) 	Phospholipids (krill oil) 
Structural form	 <p>Glycerol</p> <p>Fatty acids</p>	 <p>Choline</p> <p>Phosphate</p> <p>Glycerol</p> <p>Fatty acids</p>
Characteristics	<ul style="list-style-type: none"> • Non-polar • Hydrophobic – does NOT mix with water 	<ul style="list-style-type: none"> • Polar • Hydrophilic - mixes with water
Function	<ul style="list-style-type: none"> • Energy storage  <p>Fat reservoir</p> <p>Fat cell</p>	<ul style="list-style-type: none"> • Main structural component in all cell membranes  <p>Membrane</p>

Cardiovascular health in farmed fish



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Supply all organs with blood, oxygen and nutrition

Limited O₂ availability

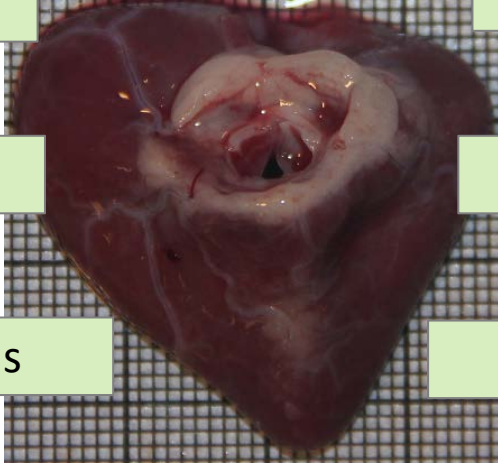
Recovery from damage

Impaired gill function

Viral diseases

Variable temp conditions

Stressful operations



Applied comparative knowledge on benefits of krill on heart health in farmed salmon

Product development



Qardio

**Investigation of mode of action
(PhD Uni. Aberdeen, NRC project 2015 – 2018)**

**Commercial trials in Norway & Scotland to
confirm effects under realistic farming conditions**

**Controlled cardiomyopathy (PRV) challenge study to determine
proof of concept & document physiological & immunological
effects.**

PRV transmission study, VESO 2013/2014



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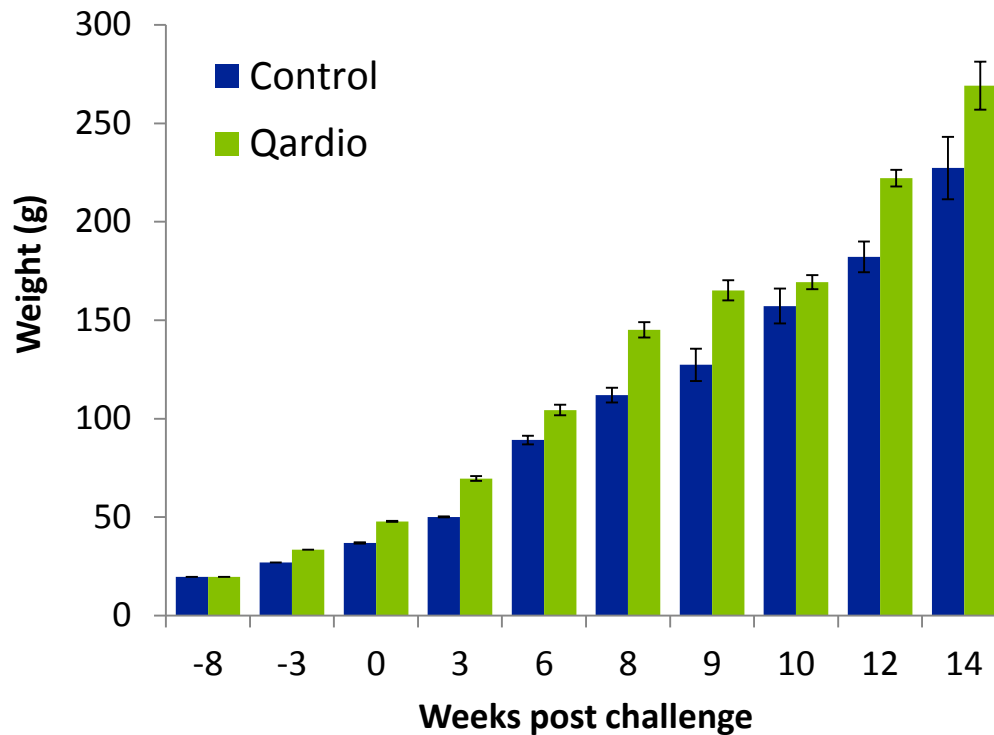
- 4 replicates/diet, basal control or Qardio
- 100 individuals/tank, start weight 20 grams
- 8 weeks of feeding pre-transmission (cohabitant PRV)
- Sampling (heart tissue for histology & genomics):
 - 0-sampling : 6 weeks pre challenge
 - At challenge (after 6 weeks of feeding)
 - 3 - 6 - 8 - 9 -10, -12 and 14 weeks post challenge



Growth during study



Average weight on sampled fish

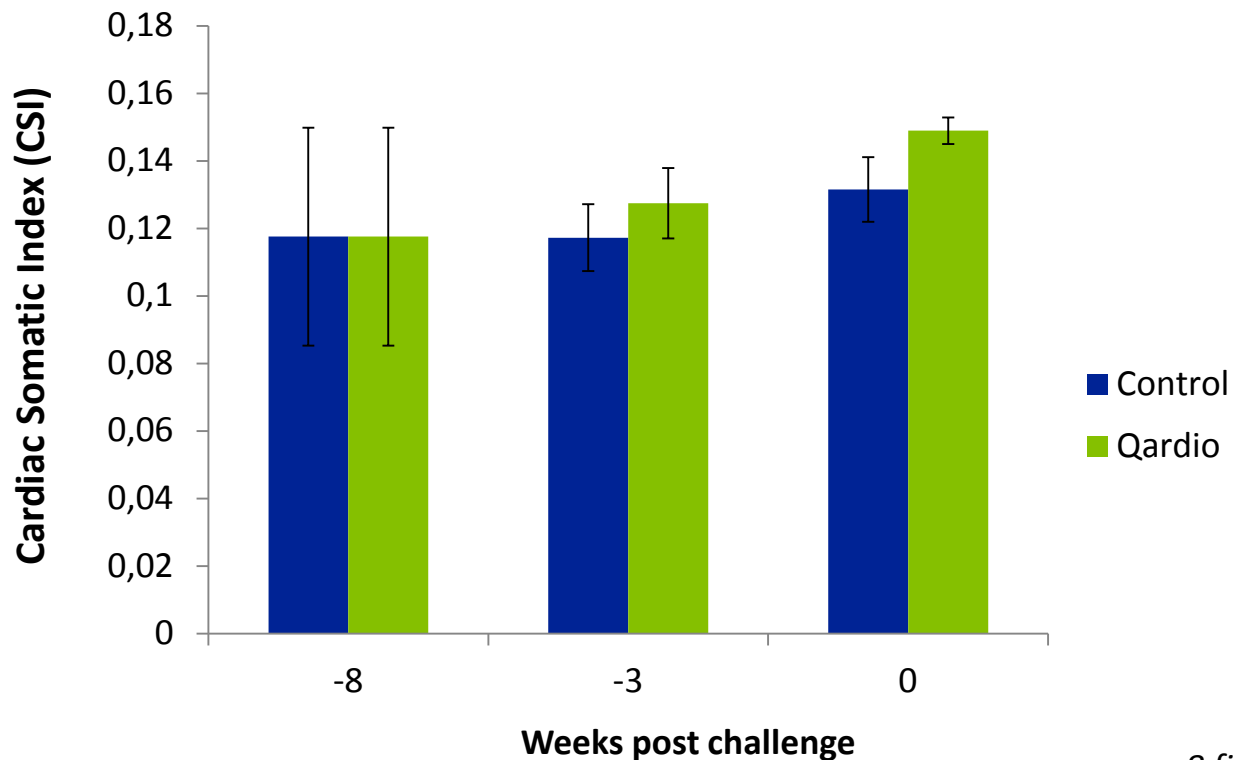


- Consistently higher growth for Qardio fed fish.

Development of heart size



Qardio



8 fish sampled per diet

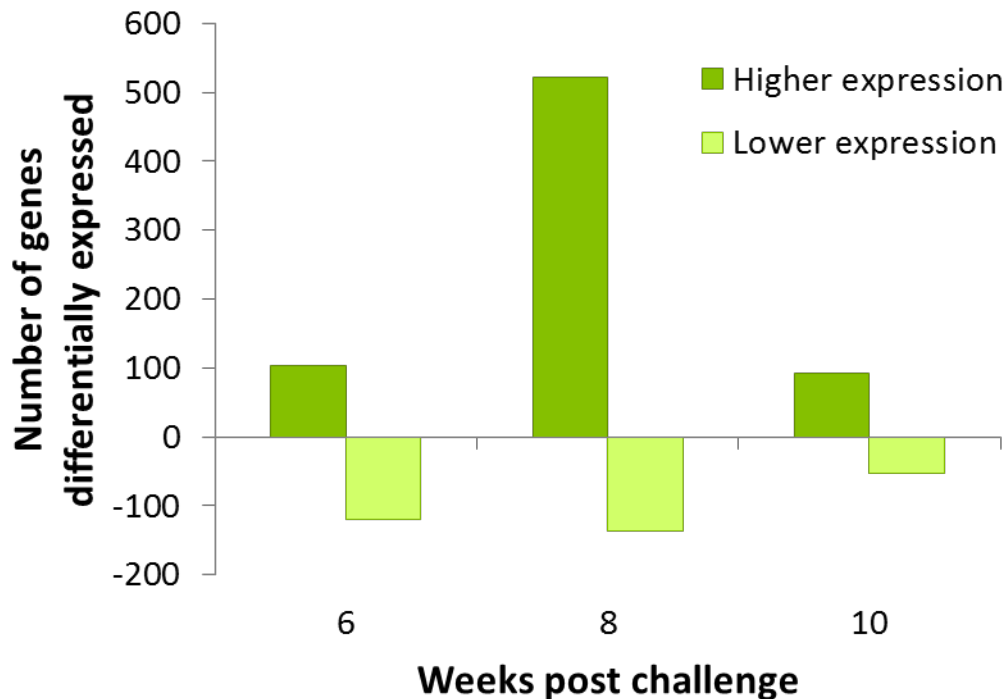
- Tendency for increased relative heart size for Qardio fed fish (nsd).

Gene expression in heart tissue

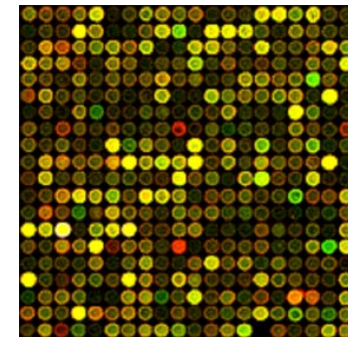


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Microarray analysis



(PhD. at University of Aberdeen.
Supervisor: Prof Sam Martin.)

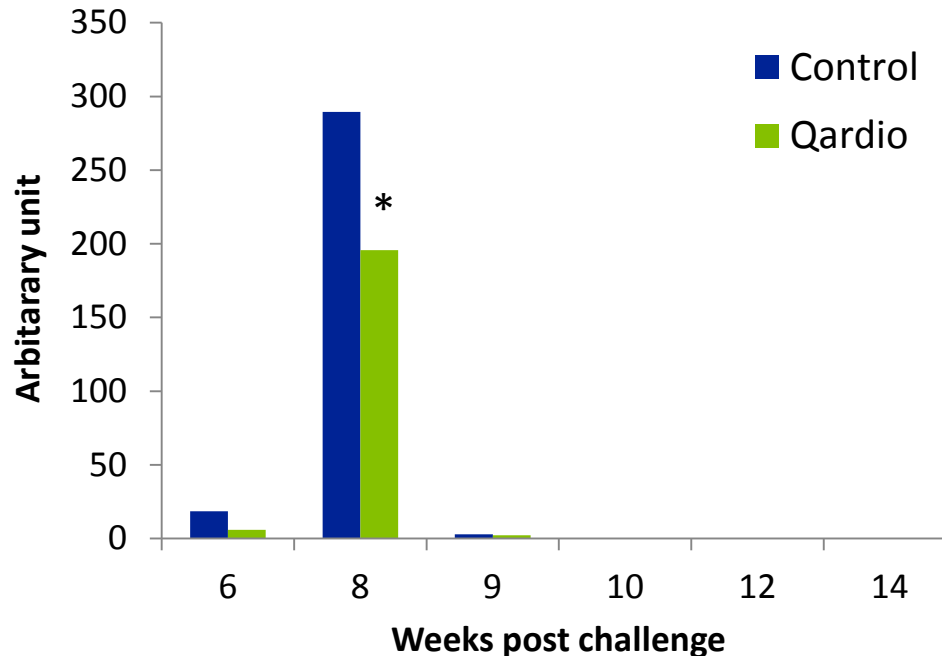


- Higher expression of genes involved in the immune defense and other cellular processes in Qardio fed fish.

Viral load in relevant organs (qPCR)



HSMI Virus load in heart



Sampled 8 fish per tank

- Lower viral load in heart tissue for Qardio fed fish ($p < 0.05$).

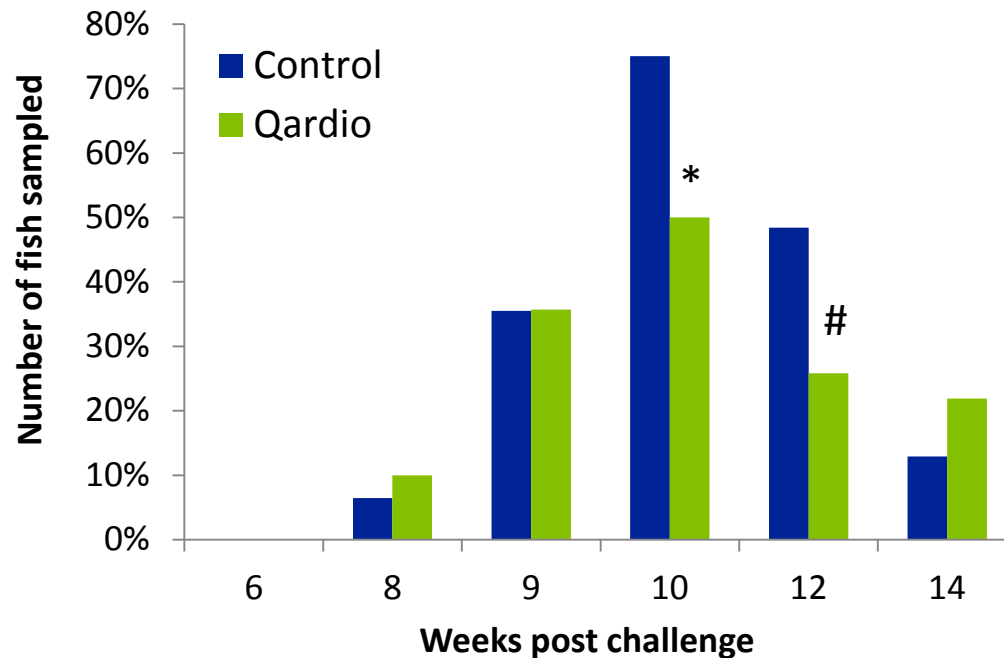
(qPCR analysis for PRV by Øystein Evensen (NMBU))

Development of heart histopathology



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Fish with severe Ventricle damage after HSMI challenge



(8 fish per tank, n= 32)

- Significantly lower number of fish with severe histopathology at peak time point of pathogenesis for fish fed Qardio ($p < 0.05$).

(Histological examination by Øystein Evensen (NMBU))

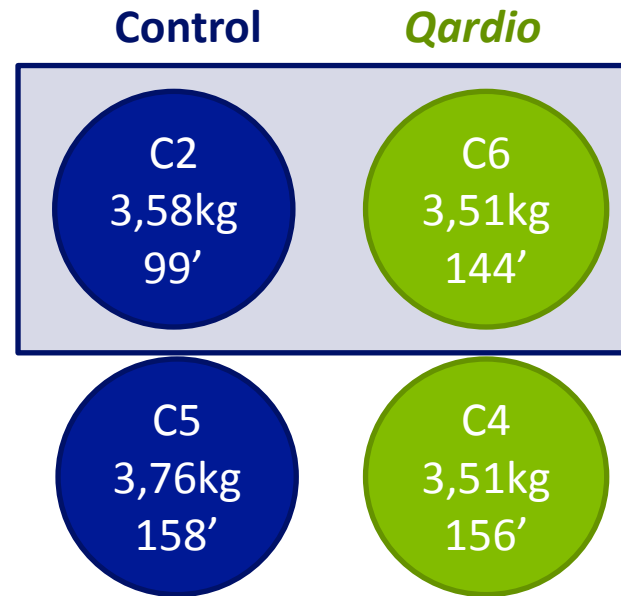
Commercial field trial 2013 - CMS



- Farm located in Mid-Norway, S1-2012
- Feed trial April - Sept 2013 (harvest)
- Duplicate pens fed control or Qardio

DISEASE HISTORY

- IPN post transfer to SW
- HSMI with prolonged mortality (all cages in 2012)
- CMS diagnosed in two of four trial cages in 2013

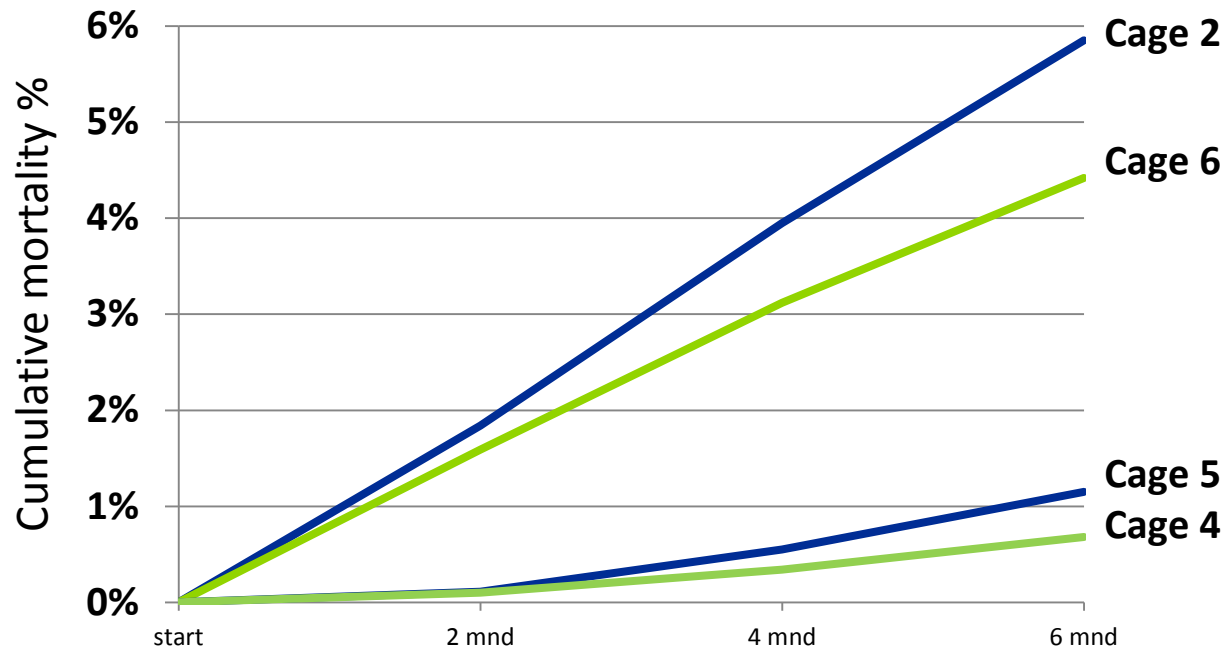


CMS signs in Cages C2 and C6

Commercial field trial 2013 - CMS



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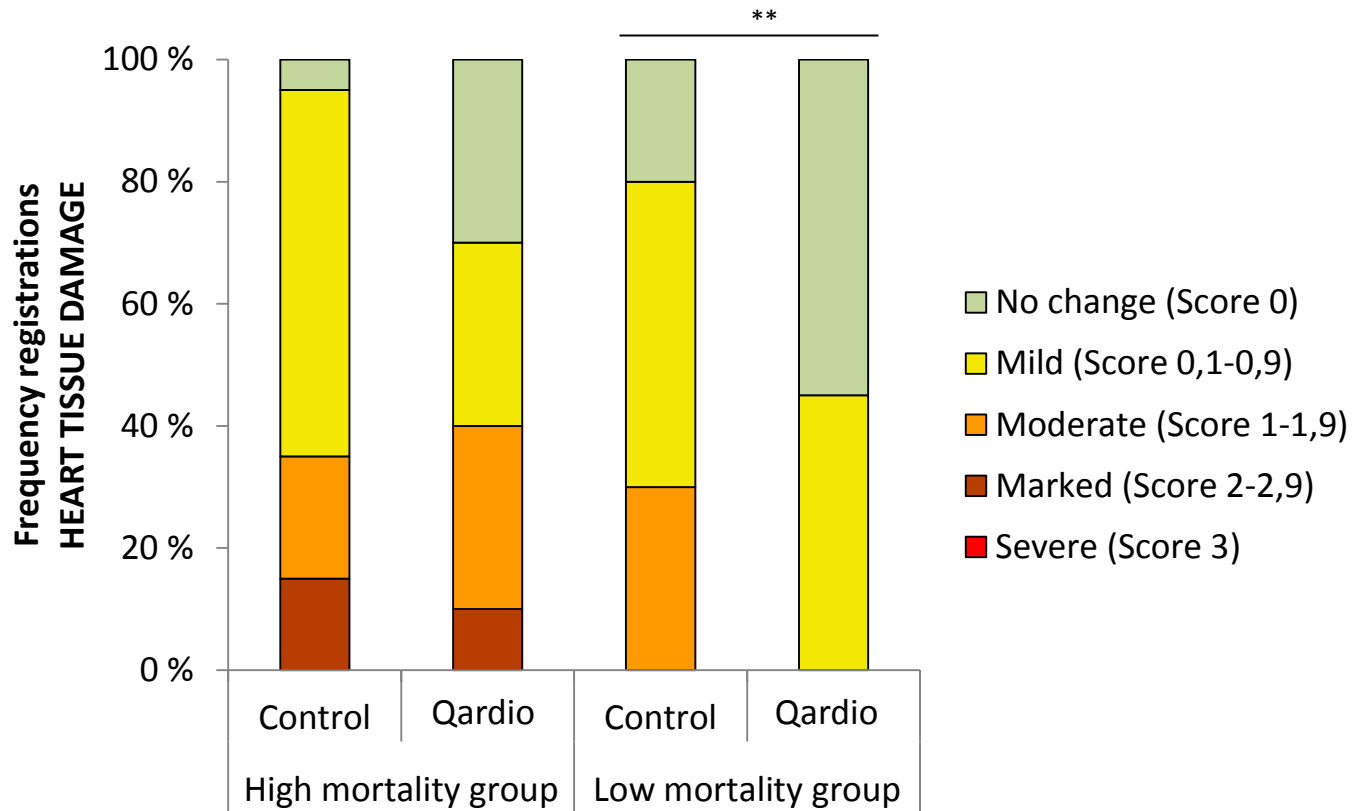
- Lower cumulative mortality for Qardio fed fish in both cage parallels



Histopathology assessment of myocard



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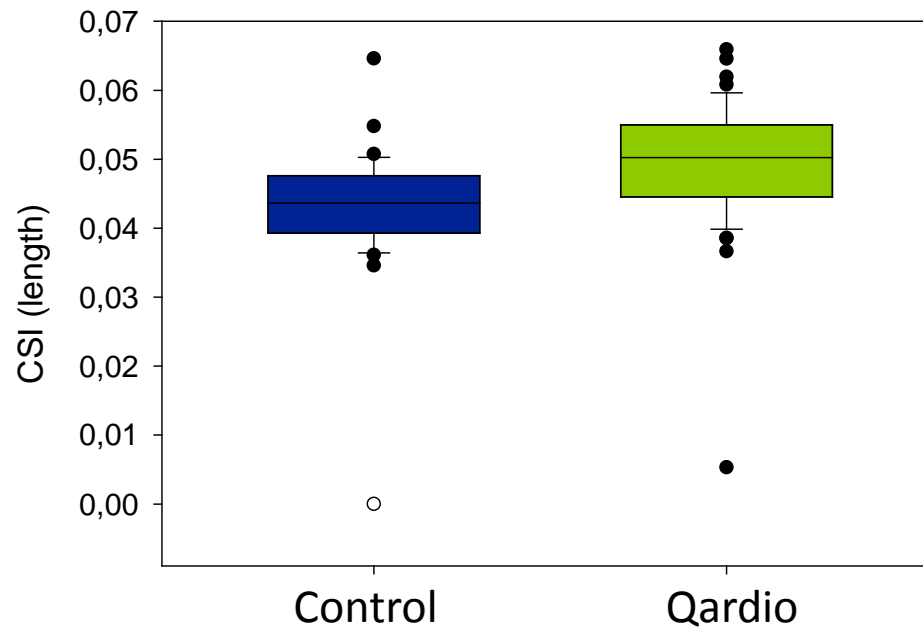


- Significant difference in histopathology score profile for Qardio fed fish.

(Histological examination by Øystein Evensen (NMBU))

Development of heart size

Cardio-Somatic Index



- Tendency for increased relative heart size for Qardio fed fish (nsd.)

Commercial field trial 2014



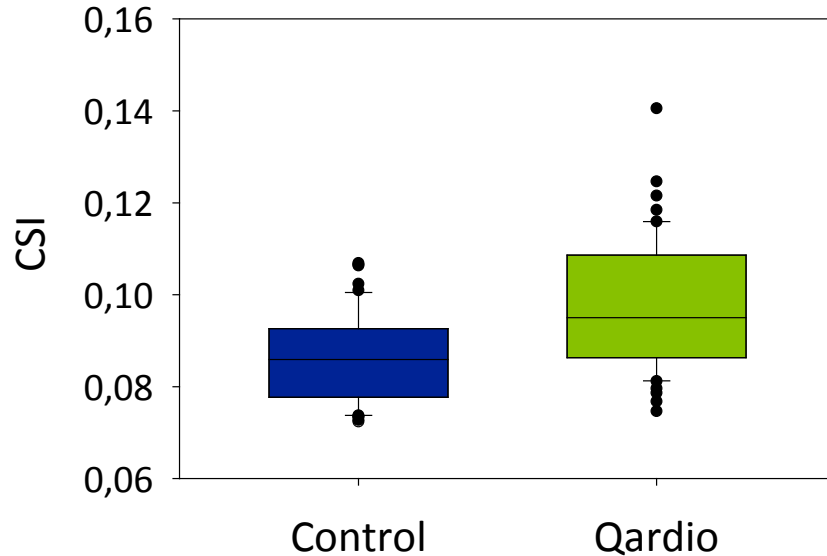
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- *Farm located in South-Norway, S1-2013.*
- *Feed trial May - Nov 2014 (4.3kg - harvest).*
- *Single pen fed control or Qardio.*
- *Site selected with historical cardiomyopathy but no disease outbreak during trial.*
- *50 fish per pen assessed at harvest for heart size.*

Commercial field trial 2014

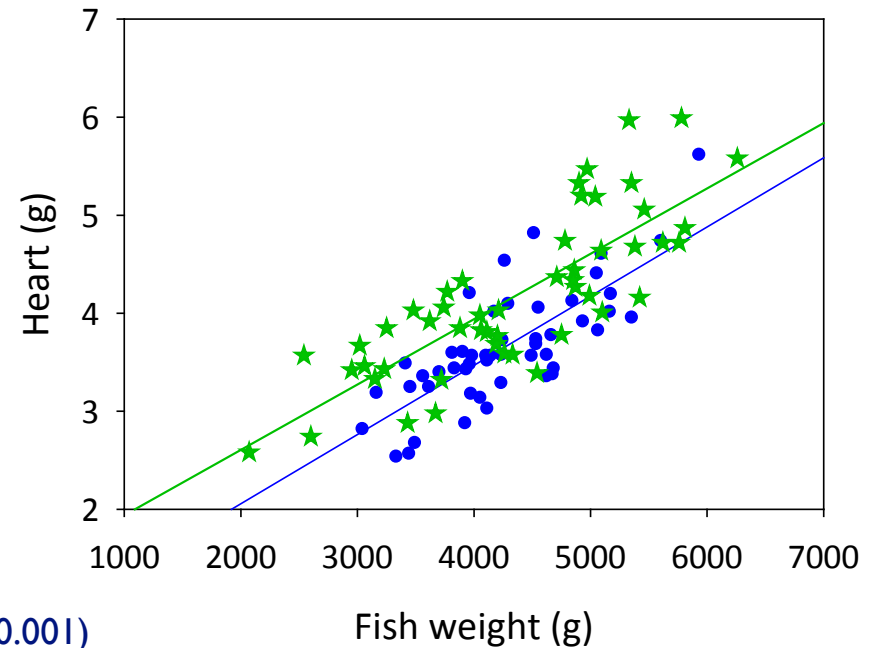


CSI - Qardio field documentation



(n=50, p<0.001)

Qardio field doc - Heart vs Fish weight



- Significantly larger heart size for Qardio fed fish

Consistent benefits to cardiovascular health



Qardio

HSMI - VESO 2013	Field trial 2013	Field trial 2014
Reduced viral count		
	Reduced mortality	
Immune response		
Reduced histopathology during viral disease		
Heart development (increased relative heart size)		





Acknowledgements

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- Christian Wallace & colleagues (VESO)
- Øystein Evensen (NMBU)
- PhD Zeynab Heidari, Prof. Sam Martin (University of Aberdeen)
- Customers for collaboration with field trials
- AkerBioMarine

For further information contact Product Manager Gunnar Molland at Gunnar.Molland@biomar.no or your local representative