Effect of pancreas disease vaccines on infection levels in Atlantic salmon challenged with salmonid alphavirus, genotype 2

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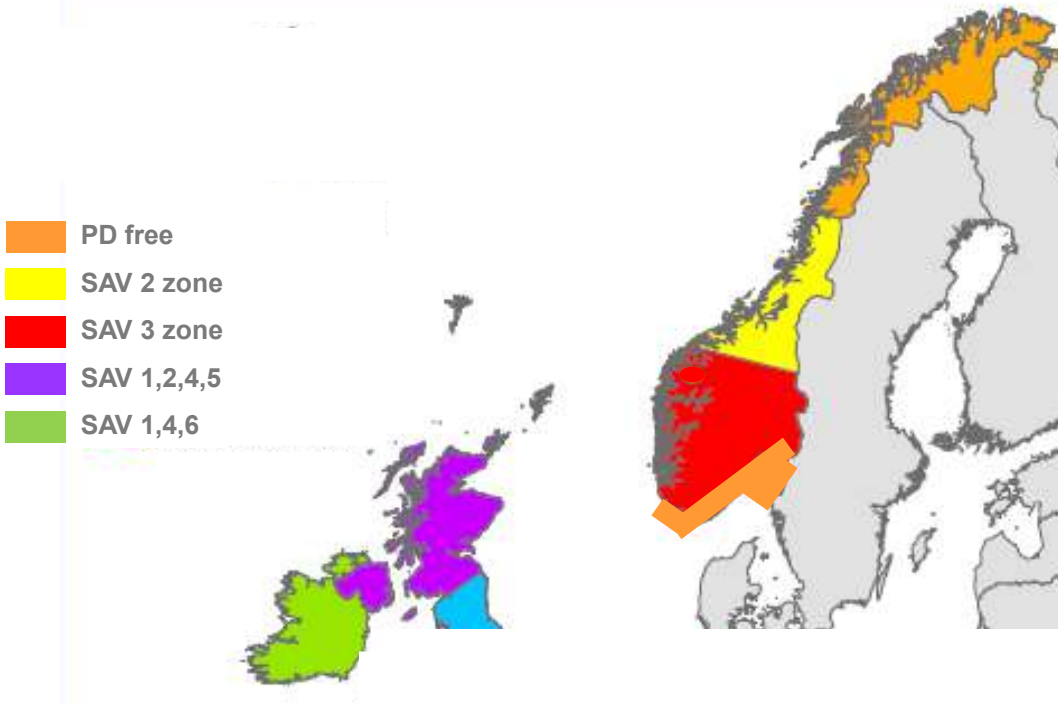
Background

*Distribution of SAV genotypes in European salmon farming**

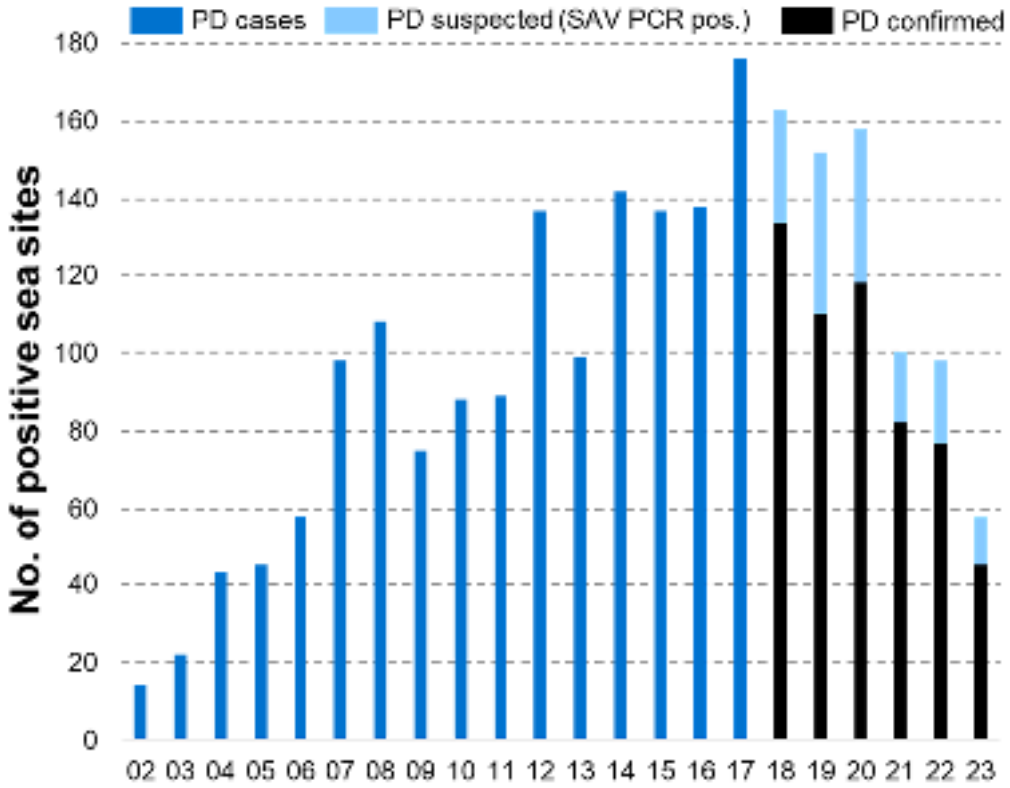


* Jansen, M.D. et al. 2017. The epidemiology of pancreas disease in salmonid aquaculture: a summary of the current state of knowledge, Journal of Fish Diseases 40(1), 141-155.

Background cont…

- PD was the most costly clinical disease for Norwegian salmon farming for many years[1]
- Reduced growth and increased FCR are the biggest cost variables of PD[1, 2]
- Marked reduction in number of suspected and confirmed PD cases in recent years[3]

PD in Norway per year 2002 - 2023[3]



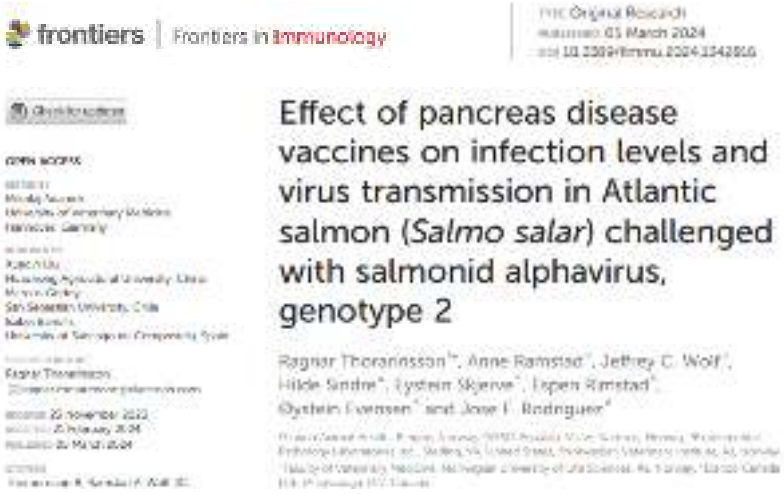
[1] Pettersen, J.M. et al., 2015. The economic benefits of disease triggered early harvest: A case study of pancreas disease in farmed Atlantic salmon from Norway. Preventive veterinary medicine. 121, 314-324.

[2] Rødsæg, M.V. et al., 2021. Effect of vaccines against pancreas disease in farmed Atlantic salmon. Journal of Fish Diseases. 44,1911-1924

[3] https://www.vetinst.no/dyr/oppdrettsfisk/pankreassykdom-pd-utbrudd-og-statistikk

Study objective

To evaluate the relative efficacy of the vaccination strategies against PD commonly used in mid-Norway (SAV2 zone)



Treatment groups

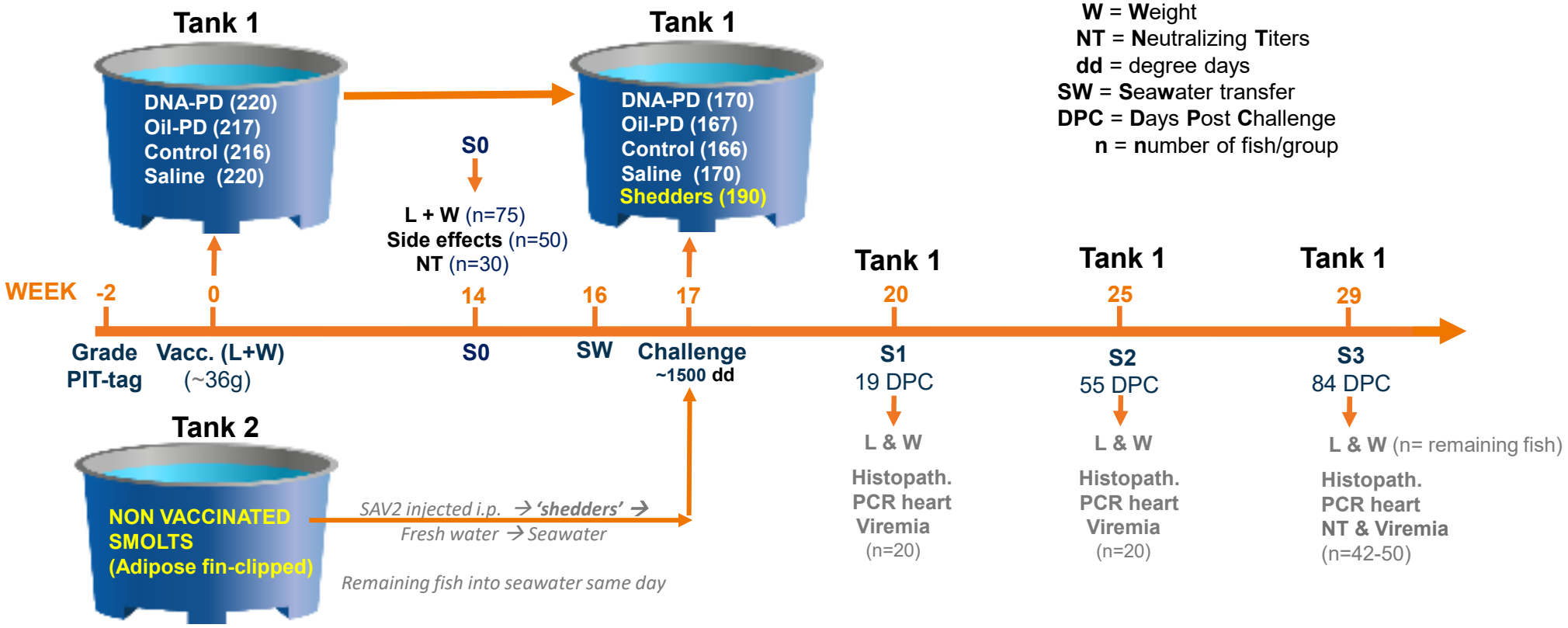
Group ID	PD vaccine Clynav (i.m. – 0.05 ml)	PD vaccine AJm-1PD (i.p. – 0.05 ml)	6-comp. vaccine AJm-6 (i.p. – 0.05 ml)	ERM vaccine Alpha ERM Salar (i.p. – 0.025 ml)	Saline (i.p. – 0.05 ml)
DNA-PD	✓		✓	✓	
Oil-PD		✓	✓	✓	
Control			✓	✓	
Saline					✓

i.m. – injected intramuscularly
i.p. – injected intraperitoneally

Experimental outline

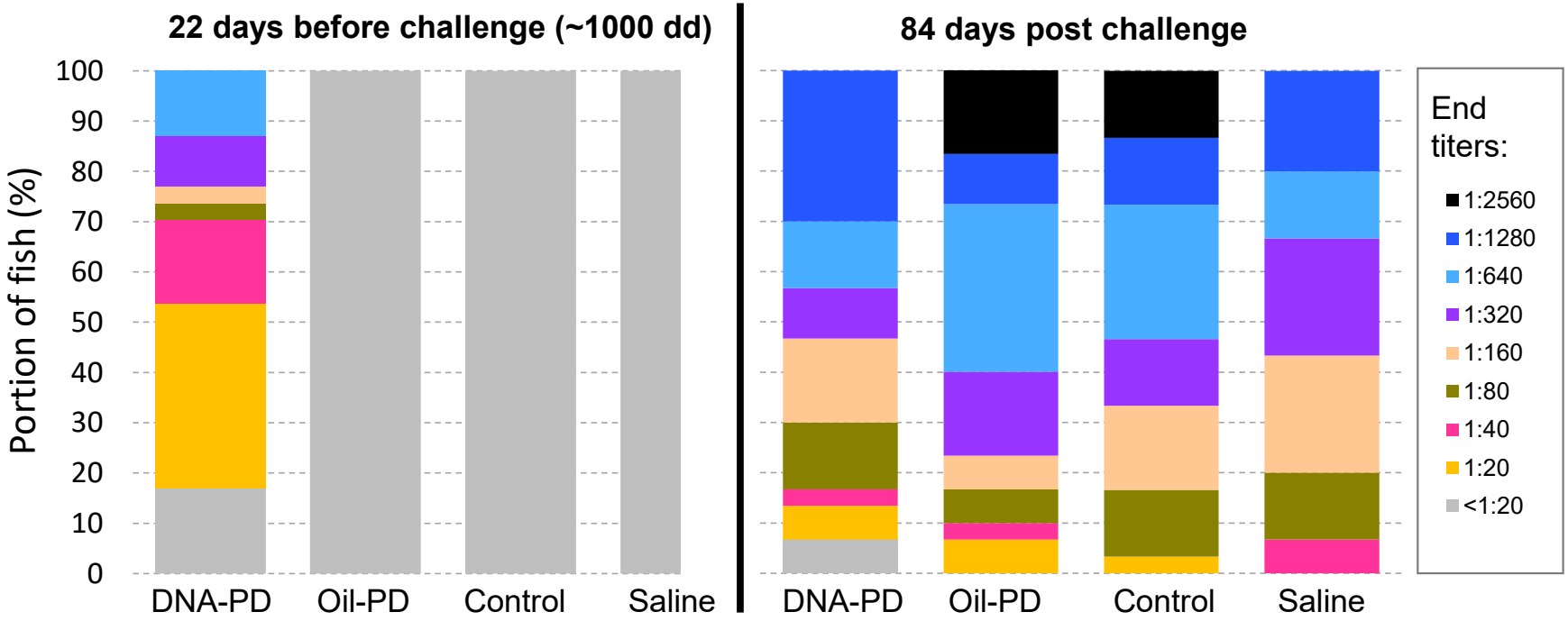
Fish held at 12-13°C

S = **S**ampling points (0 to 3)
L = **L**ength
W = **W**eight
NT = **N**eutralizing **T**iters
dd = degree days
SW = **S**ea**w**ater transfer
DPC = **D**ays **P**ost **C**hallenge
n = **n**umber of fish/group



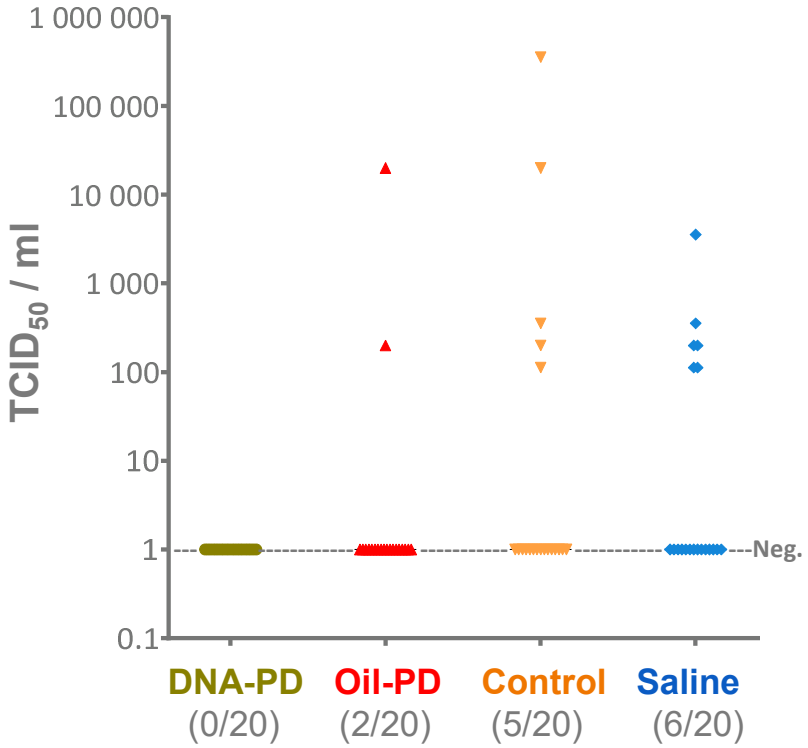
SAV2 neutralization end titers[1] prior to & at end of challenge

~1000 degree days post vaccination (n=30 fish per group)



[1] Graham, D. et al. 2003. A rapid immunoperoxidase-based virus neutralization assay for salmonid alphavirus used for serological survey in Northern Ireland. Journal of fish diseases. 26. 407-13.

SAV2 in plasma[1] (viremia) 19 dpc (n=20)



1 Jewhurst, V A, et al, 2004. Detection and antigenic characterization of salmonid alphavirus isolates from sera obtained from farmed Atlantic salmon, *Salmo salar* L., and farmed rainbow trout, *Oncorhynchus mykiss* (Walbaum). Journal of fish diseases. 27. 143-9.

Histopathology – interim data

- Specimens randomized and coded, then evaluated without knowledge of exposure group ('blinded')
- Standardized severity grading for each diagnostic criteria and tissue as previously described[1, 2]
- Tissues and diagnosis criteria 55 and 84 DPC marked bold ("**X**") will be presented:

Diagnostic criteria for each tissue type

	Heart	Pancreas	Red muscle	White muscle
Necrosis	**X**	**X**	**X**	**X**
Inflammation	**X**	X	**X**	X
Regeneration	X		X	X
Fibrosis		X	X	X
Tissue loss		**X**		

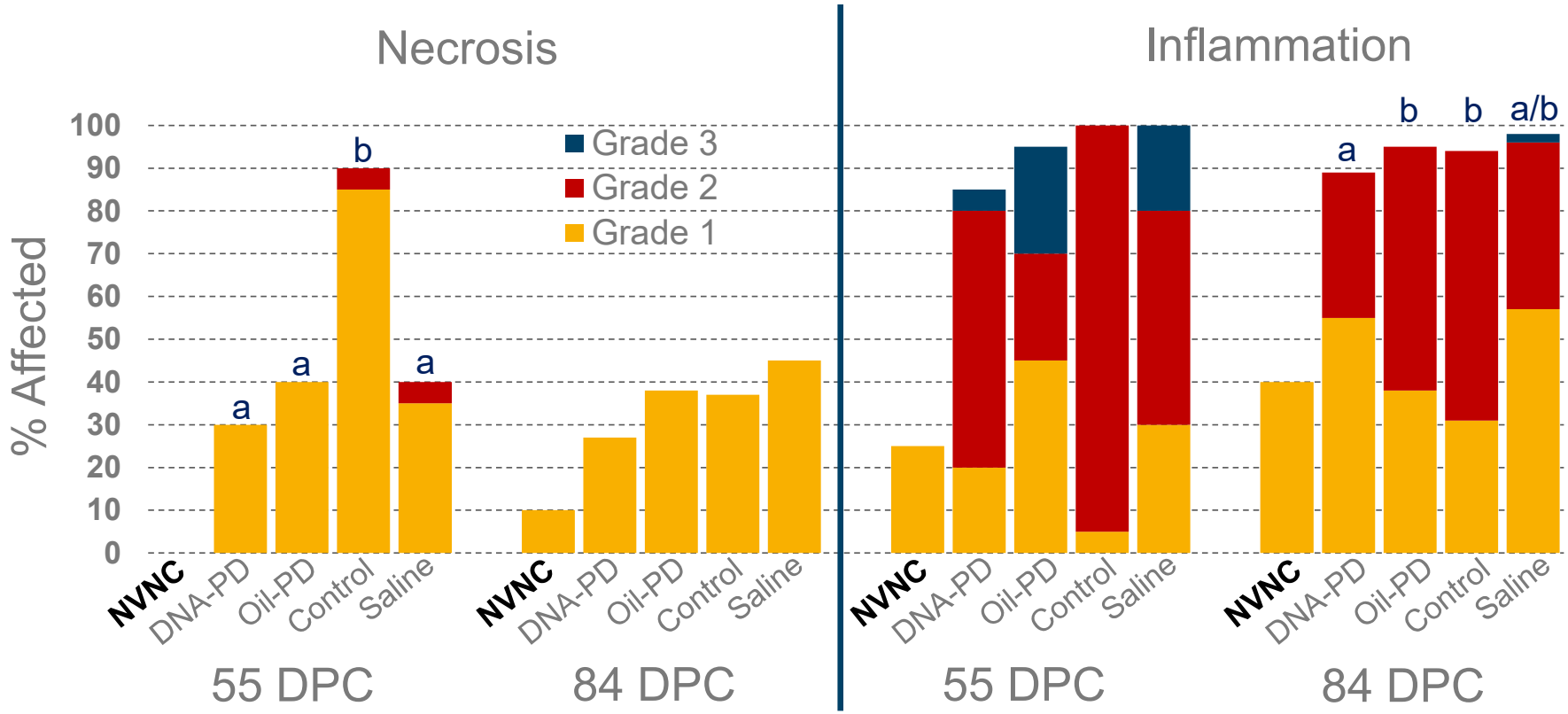
Standardized severity grading for diagnostic criteria

Grade 0	Not remarkable
Grade 1	Mild
Grade 2	Moderate
Grade 3	Severe

1 Thorarinsson, R et al, 2021. Effect of a novel DNA vaccine against pancreas disease caused by salmonid alphavirus subtype 3 in Atlantic salmon (Salmon salar). Fish & Shellfish Immunology, 108, 116–126.

2 Thorarinsson, R et al, 2022. Effect of a DNA and multivalent oil-adjuvanted vaccines against pancreas disease in Atlantic salmon (*Salmo* salar) challenged with salmonid alphavirus subtype 3. Fish & Shellfish Immunology Reports, 3, 100063.

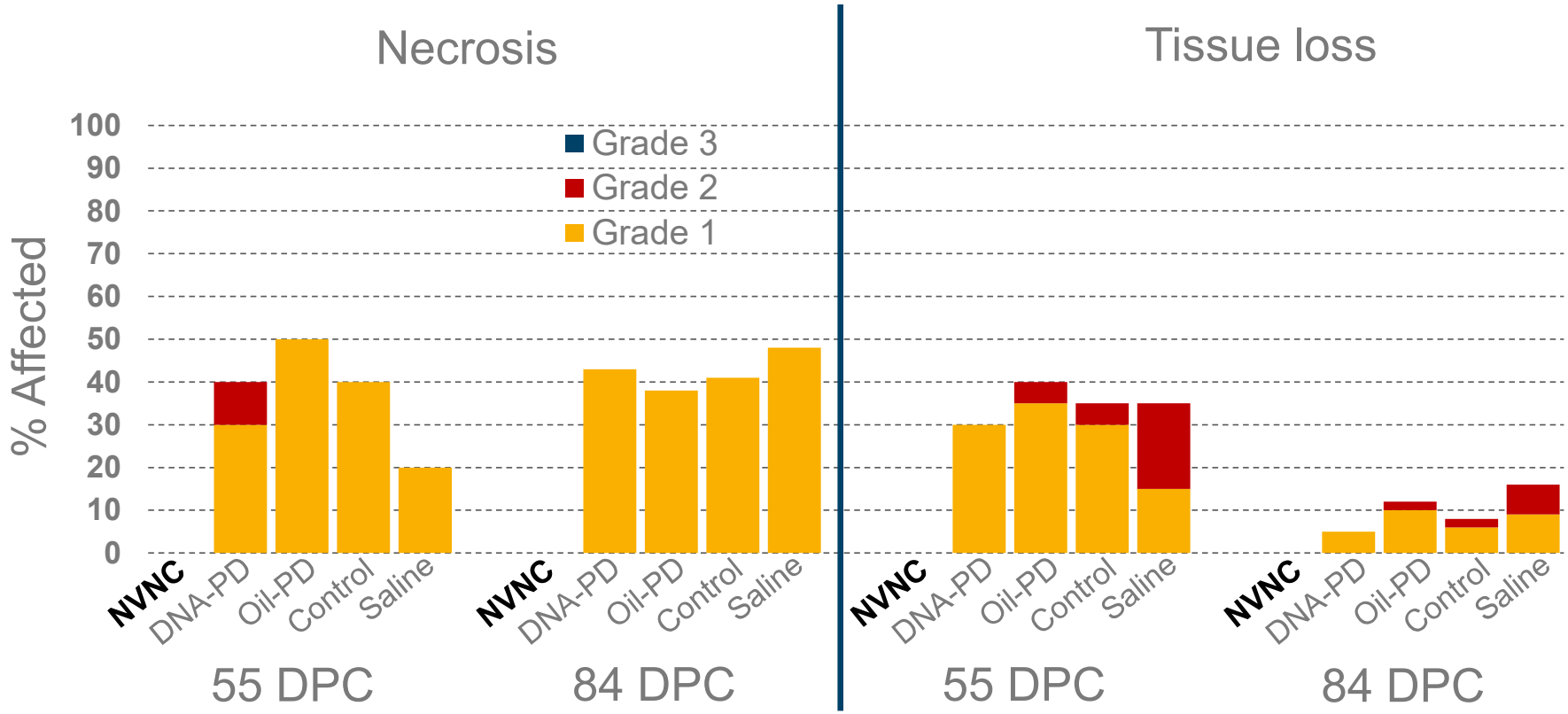
Heart necrosis and inflammation 55 (n=20) and 84 DPC (n=42-49)



***NVNC** = **N**on **V**accinated **N**on **C**hallenged (n=10)*

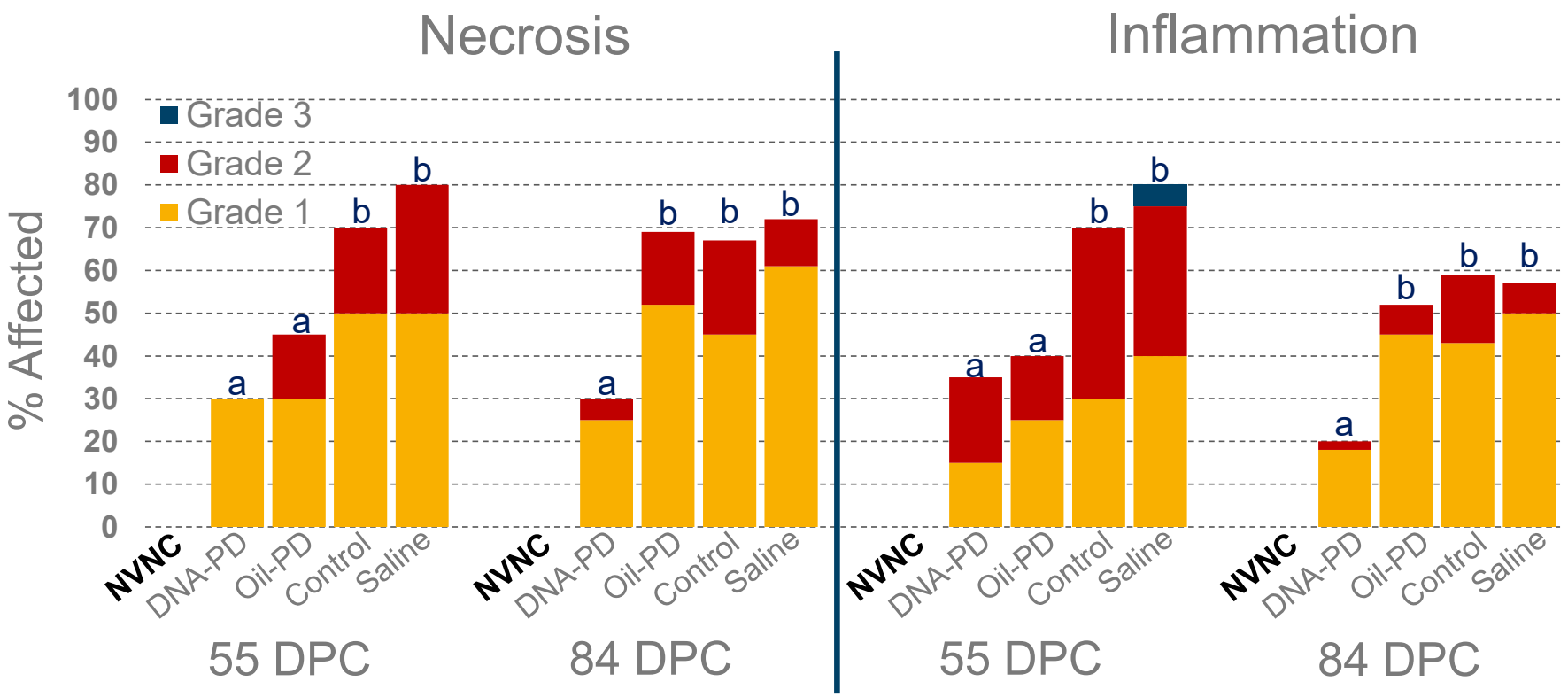
Different letters (a, b) denote significant differences (Ordinal logistic regression p<0.001).

Pancreas necrosis and tissue loss 55 (n=20) and 84 DPC (n=42-49)



***NVNC** = **N**on **V**accinated **N**on **C**hallenged (n=10)*

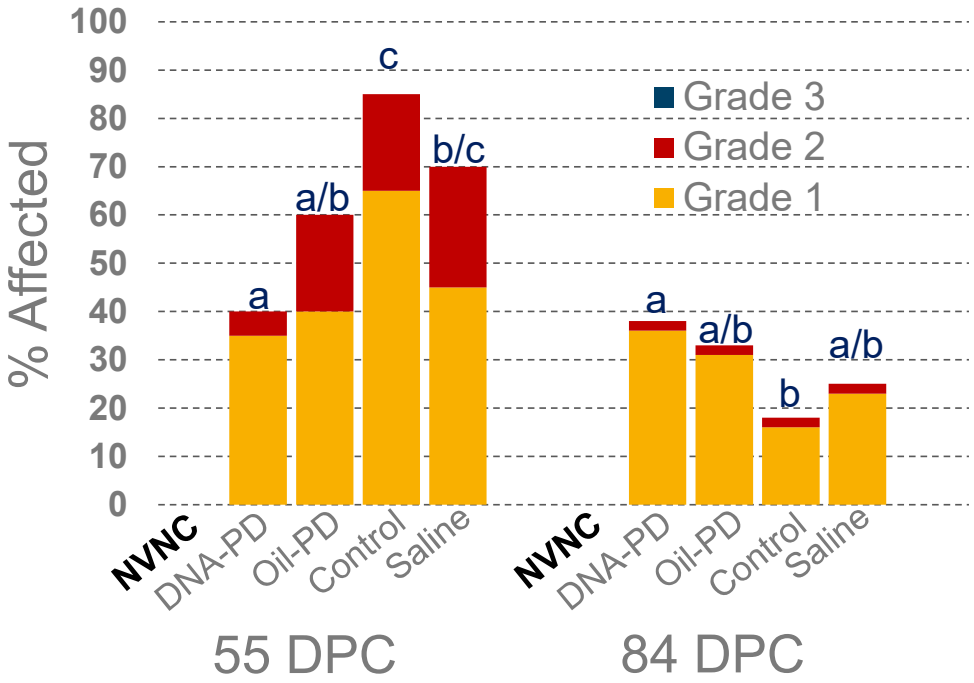
Red muscle necrosis and inflammation 55 (n=20) and 84 DPC (n=42-49)



NVNC = ***N****on* ***V****accinated* ***N****on* ***C****hallenged (n=10)*

Different letters (a, b) denote significant differences (Ordinal logistic regression p<0.04).

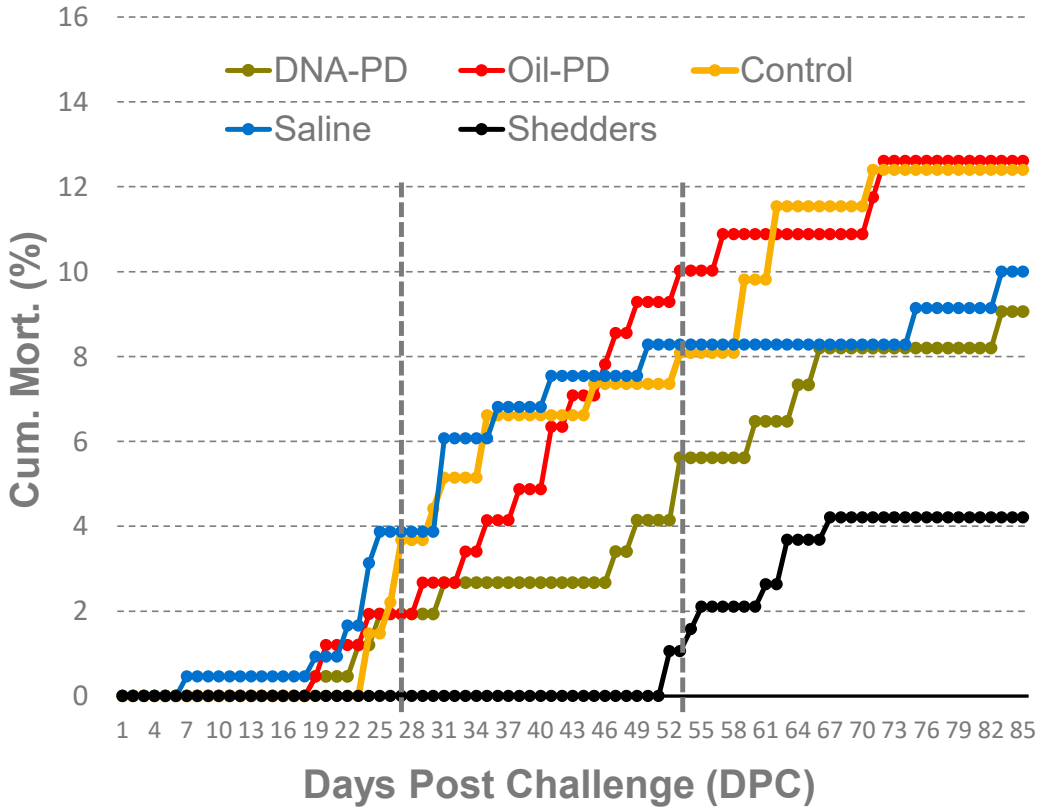
White muscle necrosis 55 (n=20) and 84 DPC (n=42-49)



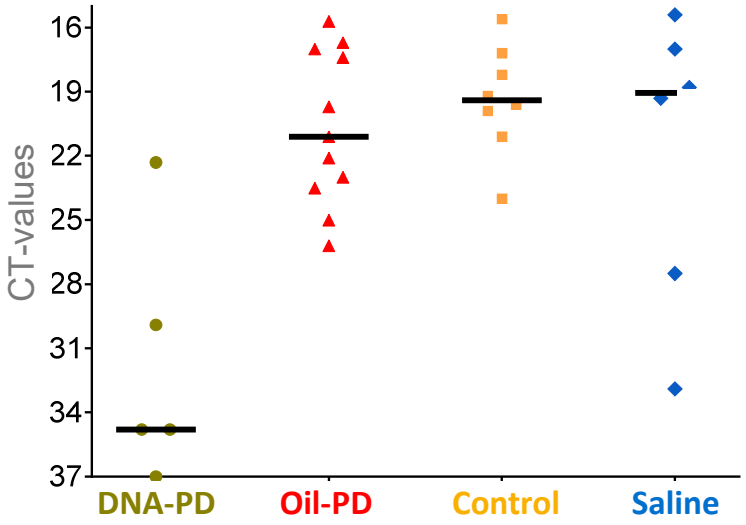
NVNC = ***N****on* ***V****accinated* ***N****on* ***C****hallenged (n=10)*

Different letters (a, b, c) denote significant differences (Ordinal logistic regression p<0.04).

Cumulative mortality*



SAV RT-qPCR dead fish 27-53 DPC**

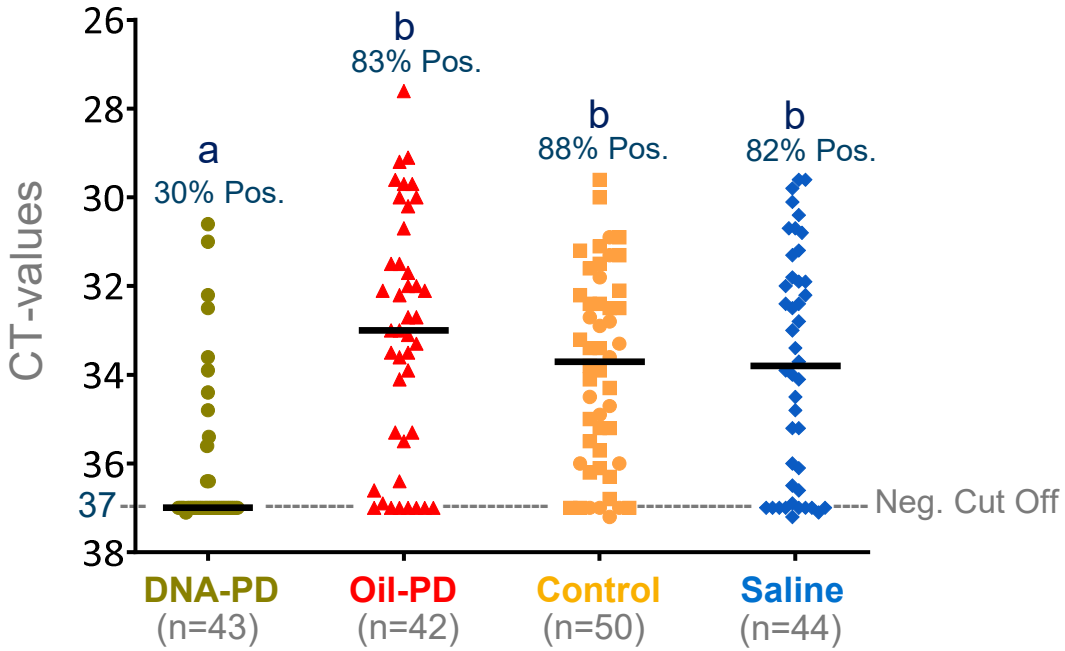


*Denominator adjusted in the calculation after each sampling

**Carried out by Patogen AS, Ålesund, Norway

SAV2 infection levels at study termination 84 DPC*

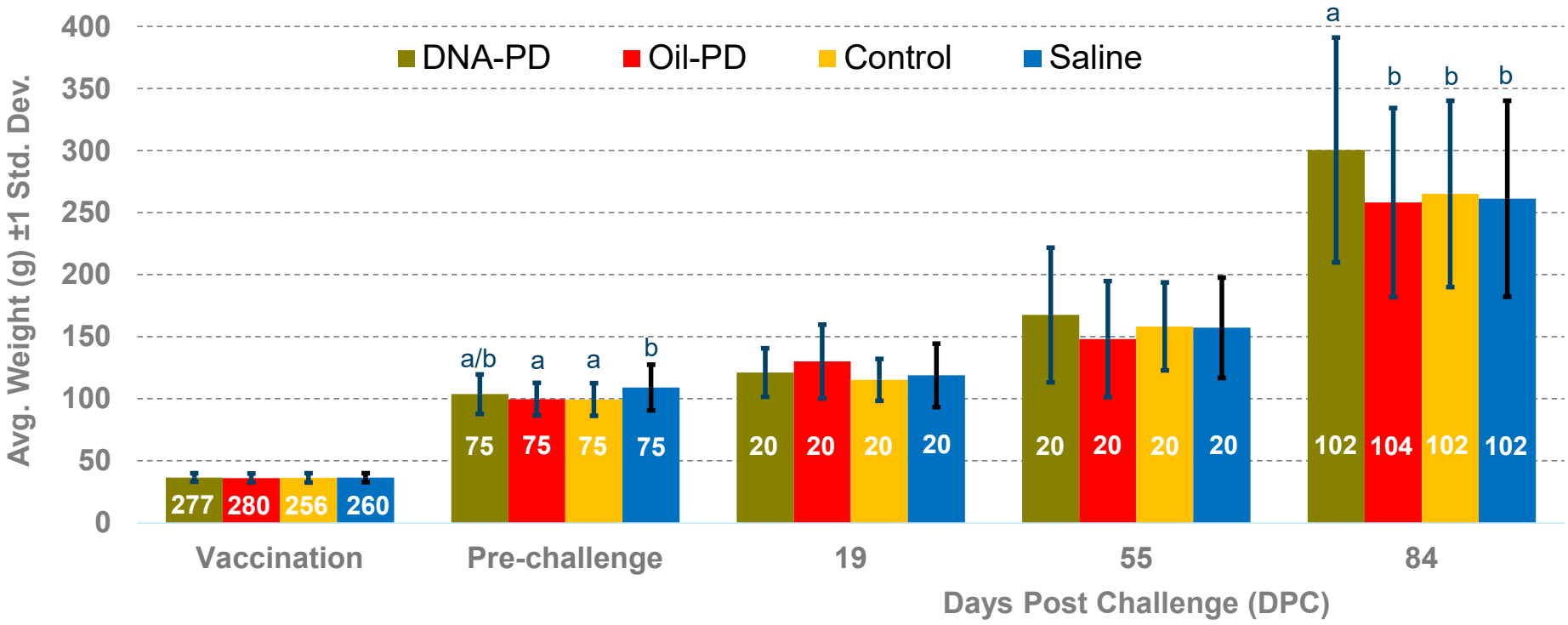
All groups had high and similar prevalence (≥90%) of PCR positive at 55 DPC (data not shown)



Different letters (a, b) denote significant differences (Median regression analysis p<0.001).

**Carried out by Patogen AS, Ålesund, Norway*

Growth prior to and after SAV2 challenge



Number inside each bar represents no. of fish (n).
Different letters (a, b) denote significant differences (Linear regression analysis p<0.015).

Conclusions

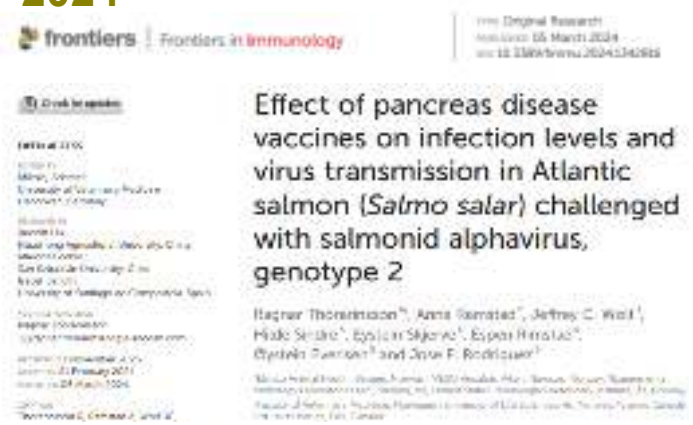
IMMUNE RESPONSE	INFECTION	PROTECTION
DNA-PD group had high prevalence (83%) of neutralizing antibodies with end titers from 1:20 to 1:640	Minimal viremia levels 19 DPC in all groups except the PD-DNA group	Mortality levels lowest in the DNA-PD group during most of the infection period
	Moderate to low levels of pancreas necrosis and tissue loss with no differences between the groups	DNA-PD group had significantly reduced SAV RNA levels (RT-qPCR) in the hearts at 84 DPC compared to the other groups
	In general, DNA-PD group had less cardiac and skeletal muscle necrosis & inflammation compared to the other groups	DNA-PD group had gained significantly more weight compared to the other groups at 84 DPC

Conclusion cont….

With exception of mortality levels, generally lower virulence of SAV2 compared earlier SAV3 studies

Current SAV2 study

2024


frontiers | Frontiers in Immunology

Effect of pancreas disease vaccines on infection levels and virus transmission in Atlantic salmon (*Salmo salar*) challenged with salmonid alphavirus, genotype 2

Earlier SAV3 studies

2021


Fish and Shellfish Immunology

Full length article

Effect of a novel DNA vaccine against pancreas disease caused by salmonid alphavirus subtype 3 in Atlantic salmon (*Salmo salar*)

2022


Fish and Shellfish Immunology Reports

Efficacy of a DNA and multivalent oil-adjuvanted vaccines against pancreas disease in Atlantic salmon (*Salmo salar*) challenged with salmonid alphavirus subtype 3

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Thank you

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