Fish vaccination and therapy in aquaculture

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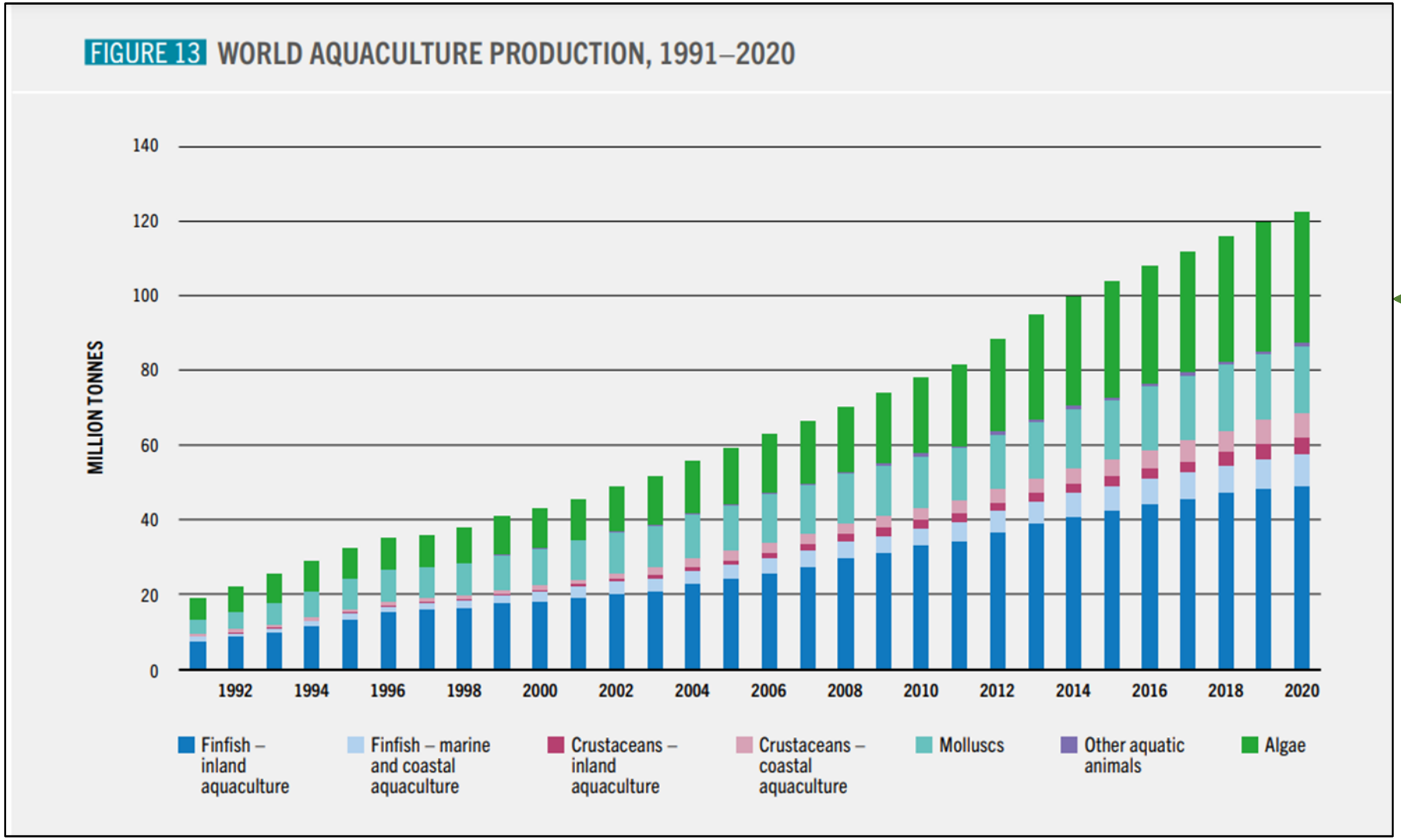
National Reference Laboratory for fish, mollusc and crustacean diseases

II Webinar of the WOAH National Focal Points for Aquatic Animals in Europe
Online 05/12/2024

The main species farmed are freshwater finfish above all cyprinids



Algae

Cyprinids

Bacterial diseases are still important everywhere

“bacterial pathogens cause major losses to aquaculture, comprising around 34% of total diseases”

Soibam Khogen Singh, Maibam Malemngamba Meitei, Tanmoy Gon Choudhary, Ngasotter Soibam, Pradyut Biswas, Gusheinzed Waikhom,(2022) Chapter 15 - **Bacterial diseases in cultured fishes: an update of advances in control measures,** Bacterial Fish Diseases,Academic Press,

Billions of dollars are lost every year

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Main bacterial pathogens in European countries

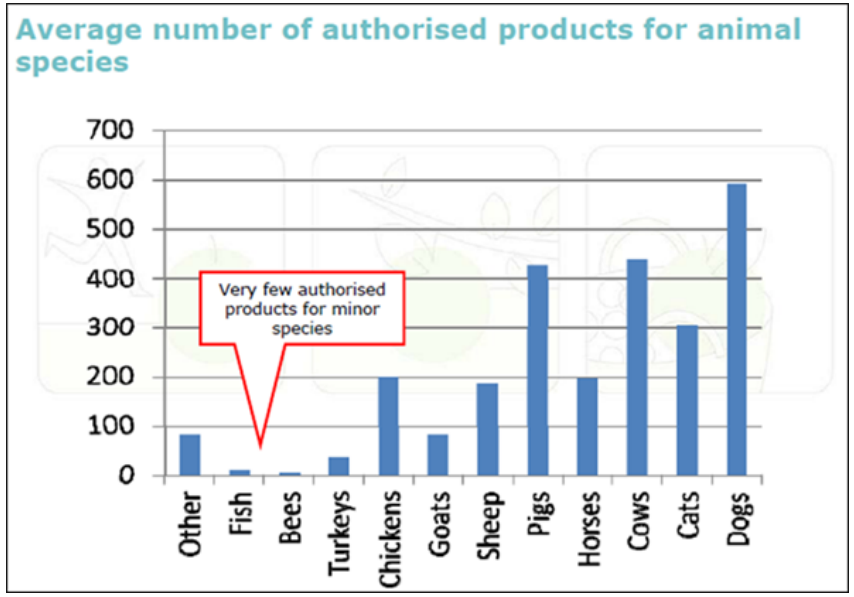
Pathogen	Susceptible fish	Pathogen	Susceptible fish
Aeromonas salmonicida	Salmonids	***Photobacterium damselae subsp. damselae***	Marine species
Aeromonas spp. (motile)	Warm water species	***Photobacterium damselae subsp. piscicida***	Marine species
Edwarsiella ictaluri/E. tarda	Warm water species	***Pseudomonas spp.***	Fresh water species
Flavobacterium psychrophilum	Salmonids	***Renibacterium salmoninarum***	Salmonids
Flavobacterium columnare	freshwater and ornamental species	***Tenacibaculum spp***	Marine species
Francisella notuanensis	Salmonids	***Vibrio anguillarum***	Marine species
Lactococcus garvieae	Rainbow trout Warm water species	***Vibrio harveyi***	Marine species
Mycobacterium spp.	Mainly ornamentals	***Vibrio spp***	Marine species
Moritella viscosa	Salmonids		

Antibacterial approved in EU (European Medicine Agency-CVMP 2023)

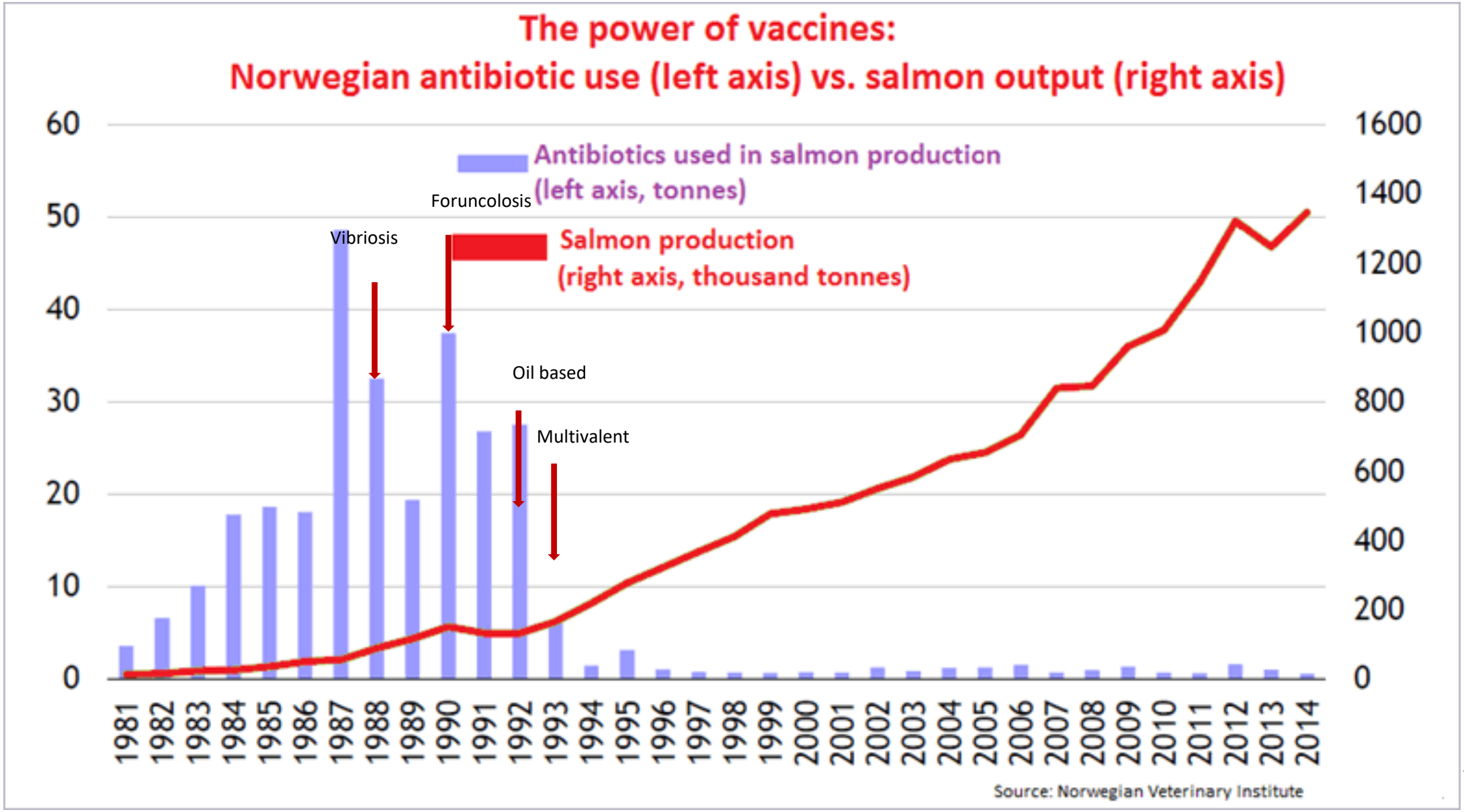
	N	GB	GR	ES	I	F	DK	PL	CZ	D	H	FL	IE	S	HR	IS	NL	P	BG	RO
Amoxicilline		X			X															
Clortetracicline																				
Enrofloxacin																			X	X
Florfenicol	X	X	X		X	X	X		X		X				X			X	X	X
Flumequine			X	X	X	X													X	X
Oxolinic acid	X		X			F	X													
Ossitetracicline		X	X	X	X	X		X	X			X	X		X			X	X	X
Sulfam./Trim.			X		X	X				X										

Main problems to perform antimicrobial therapy: outbreak management

- It’s not easy to understand when and where the disease has started.
- Only therapy with **medicated feed** is allowed.
- **Sick animals don’t eat** and it’s impossible to perform individual therapy (like for a cat, dog or beef).
- **Prophylactic treatment are forbidden** but you need to start with methaphylactic therapy (to avoid the spread of infectious disease to healthy fish).
- There is a real lack of veterinary medicine in Europe



Conclusions: the best solution to reduce antibiotic use is vaccination



Vaccination: the PAST

- History of vaccination in fish started in 1938 with the first report of protective immunity in carp immunized with *Aeromonas punctate*
- In 1942 Dr Duff showed protection against *Aeromonas salmonicida* in trout immunized by parenteral inoculation and by oral administration
- The first vaccine for aquaculture (against *Yersinia ruckerii* in salmonid fish) was licensed in USA in 1976
- Introduction of adjuvants
- Improved knowledge of fish immune system


Fish & Shellfish Immunology 35 (2013) 1683–1688

Contents lists available at ScienceDirect

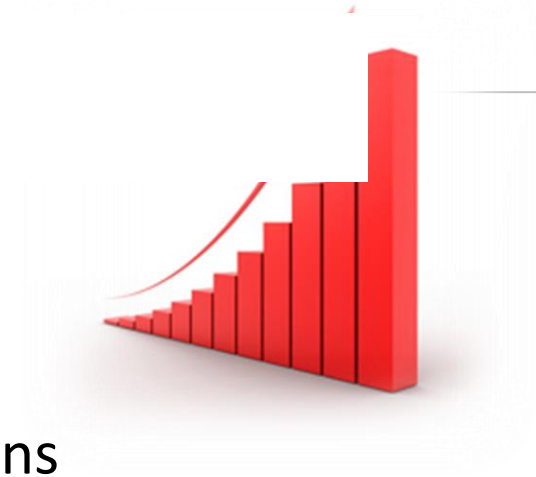
Fish & Shellfish Immunology

journal homepage: www.elsevier.com/locate/fsi

A history of fish vaccination
Science-based disease prevention in aquaculture

Roar Gudding [a,*], Willem B. Van Muiswinkel [b]

THE PRESENT



- 1982 : 2 vaccines avaibale - ~100 scientific pubblications
- 2014 : ~25 fomulations available
- **2020** : > 40 formulations avilable - >10.000 scientific pubblications
- Mainly inactivated vaccines
- Few live attenuated vaccines
- IP or bath administration

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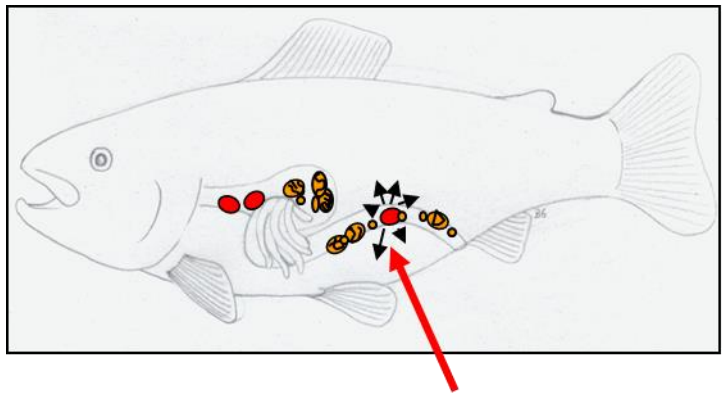
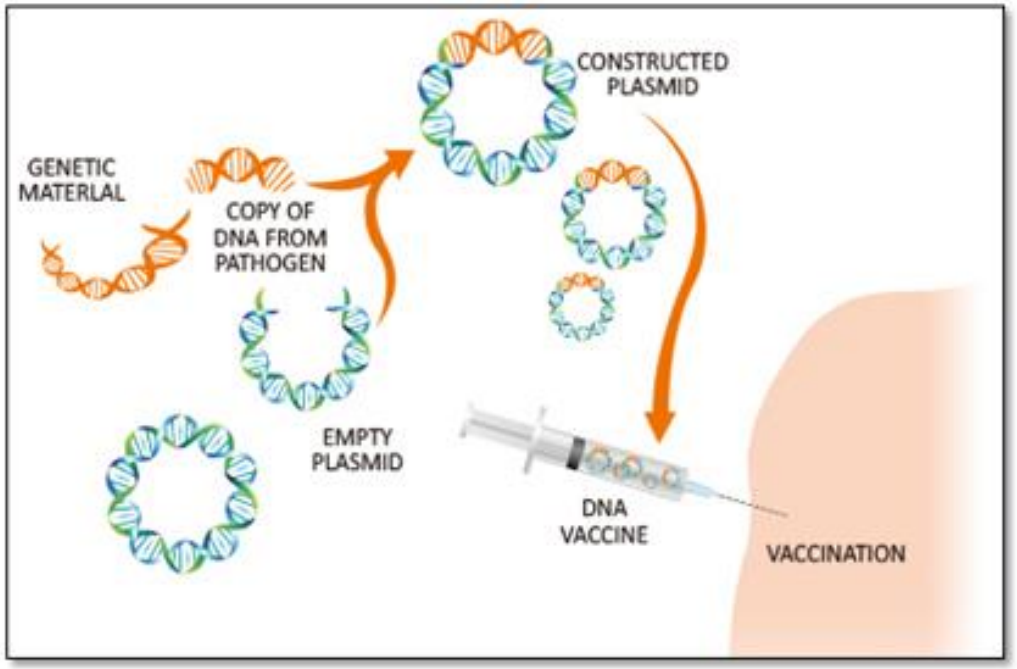
Adminstration route

- Bath/immersion
- Intraperitoneal
- Intramuscular
- Oral administration



GALT-Gut Associated Lymphoid Tissue

DNA-VACCINE



Uttaranchal (P.G.) College Of Bio-Medical Sciences & Hospital

Based on te concept that deoxyribonucleic acid (DNA) can be utilized alone as vaccine

Naked plasmid DNA following uptake in cells of the vaccinated host mediates expression of the viral protein and therefore trigger the immunoresponse

Advantage:

- Low doses
- Rapid and long lasting protection
- Cheap and safe
- Stable

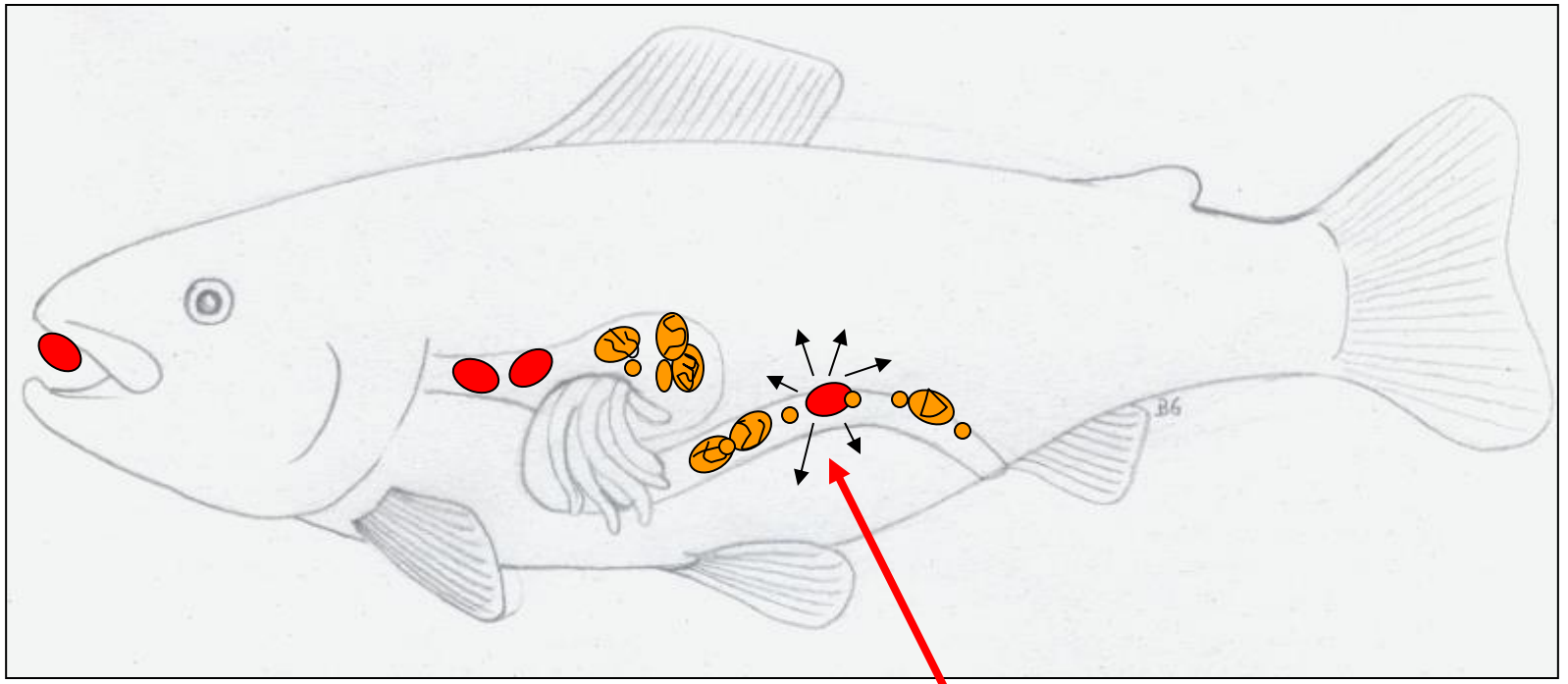
Disadvantage:

- Not applicable to all pathogens
- Regulatory constrains

ORAL VACCINES

- *Yersinia ruckeri* – oral vaccine for trout containing inactivated bacteria
- IPN - oral vaccine for salmon containing capsid VP2 – VP3 protein IPNV, (expressed in *Pichia pastoris*), encapsulated in alginate microspheres
- Piscirickettsiosis-oral vaccine containing inactivated *P. salmonid* feed incorporated
- Promising experimental results of orally administered DNA plasmids against VNN and VHS

Low response by oral vaccination



GALT-Gut Associated Lymphoid Tissue

NEXT FRONTIERS

DIVA STRATEGY

- **D**ifferenziating **I**nfected from **V**accinated **A**nimals
- This strategy is largely used for mammals/birds, are there possible application for fish?
- **RNA vaccine**

VACCINE AGAINST PARASITE

University of Bergen, Department of Biology

Commercial vaccines authorized in Europe - 2024

Patogeno	Specie ittica	Stato europeo
A. salmonicida	Atlantic salmon	PT
A. salmonicida + V.anguillarum O1,O2	Atlantic salmon	DK,FI,IS,NO
A. salmonicida, L.anguillarum O1, O2a, V. salmonicida, Moritella viscosa	Atlantic salmon	DK,FI,IS,NO
A. salmonicida, L.anguillarum O1, O2a, V. salmonicida, Moritella viscosa, IPN Virus serotype Sp e A2	Atlantic salmon	IE,NO
Lactococcus garvieae	Rainbow trout	FR,EL, I,PT,ES
Moritella viscosa	Atlantic salmon	Norway
Ph. damselae subsp. piscicida	Sea bass	FR, EL, ES, CY
Streptococcus parauberis	Turbot	FR,EL,PT,ES
Tenacibaculum spp.	Turbot	ES
V. anguillarum + Ph. piscicida	sea bass	HR, I;FR,EL;ES
V. anguillarum + *V. ordalii*	Rainbow trout	CY,FR,EL,I
V. anguillarum + *V. ordalii*	Rainbow trout	CY,FR,EL,I,PT,ES
V. anguillarum O1 strainAL 112	Sea bass	HR, EL;PT,ES
V. anguillarum O1,O2 V.salmonicida, A. salmonicida, M. viscosa+ IPN	Atlantic salmon	IE,UK
V. anguillarum O1,O2 V.salmonicida, A. salmonicida, M. viscosa+ IPN+Infectious Salmon AnemiaVirus (ISAV)	Atlantic salmon	NO
V. anguillarum O1,O2α e O2β strain	Sea bass, turbot	FR,EL
V. anguillarum, Ph. damselae, A. salmonicida	sea bass	ES
V. anguillarum, V.salmonicida, A. salmonicida, M. viscosa	Atlantic salmon	
V. anguillarum, V.salmonicida, A. salmonicida, M. viscosa+ IPN	Atlantic salmon	Norway
Yersinia ruckeri biotype 1 and 2	Atlantic salmon, Rainbow trout	CZ,FR,FI,DE,I,NO,PT,SK,ES,UK
Yersinia ruckeri O1 b	Atlantic salmon, Rainbow trout	CZ,F,D,Gr,IE, I, NO, PL, PT,SK,UK

Autogenous vaccines available in EU 2023 (EMAV paper 082023)

- Autogenous vaccines against **Francisella orientalis** subsp nov. in **Tilapia** (*Oreochromis niloticus)*
- Autogenous vaccines against **Lactococcus garvieae** in **fish**
- Autogenous vaccines against **Streptococcus agalactiae** in **tilapia**
- **Tilapia Lake Virus** (TiLV) in **Tilapia** (*Oreochromis niloticus*)
- Autogenous vaccines against **ISKNV (Infectious Spleen and Kidney Necrosis Virus)** in **Tilapia** (Oreochromis niloticus)
- Autogenous vaccines against ***Aeromonas veronii*** in **fish**
- Autogenous vaccines against ***Vibrio harveyi*** in **fish**
- Autogenous vaccine against ***V. anguillarum*** in **Atlantic cod**
- Autogenous vaccine against Pasteurella spp. (***Pasteurella skyenis and Pasteurella atlantica)*** genomovar salmonicida in **Atlantic salmon**
- Autogenous vaccine against ***Moritella viscosa*** in **Atlantic salmon**

No money…no vaccines..quite expensive to register a new VMPs

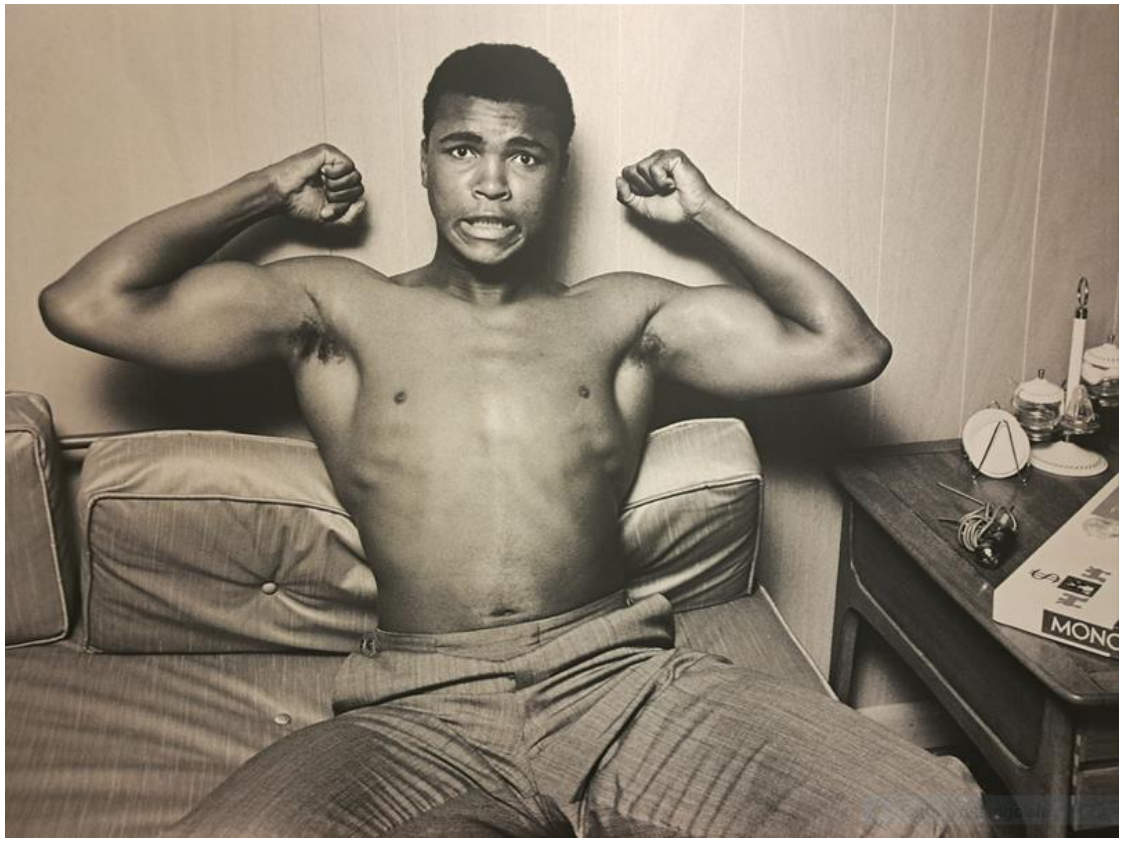
KLIFOVET AG
ADDED VALUE TO ANIMAL HEALTH

Cost for new MA (Dir 2001/82, Art. 12)

Part of Dossier		Costs in 1.000 €
Part I: administrative data		~25-35
Part II: Quality of the product		~200-300
Part III:	Toxicology	~250
	Target Animal Safety	~150
	User and Environmental Safety	~500-1.000
Part IV:	Efficacy	~250-1.000
Fees at Authorities		~ 50-200
Project Management, Dossier Preparation, Meetings etc.		100-250
Total development costs:		**1.000-2.500**

13

THANK YOU FOR YOUR ATTENTION!



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