สวทช NSTDA

งานประชุมวิชาการประจำปี สวทช. ครั้งที่ 17

NAC2022 17th NSTDA Annual Conference

พลิกฟื้นเศรษฐกิจและสังคมไทย
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"Revitalizing Thai Economy through BCG Research and Innovation"

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แนวโน้มตลาดวัคซีนสัตว์น้ำในประเทศไทย ในมุมมองของ Start up

รศ.น.สพ.ดร. ชาญณรงค์ รอดคำ

AQUA INNOVAC Co.Ltd.

คณะสัตวแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

CHULALONGKORN UNIVERSITY TECHNOLOGY CENTER

AQUA INNOVAC
Innovation for aquatic animal health

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AQUA INNOVAC

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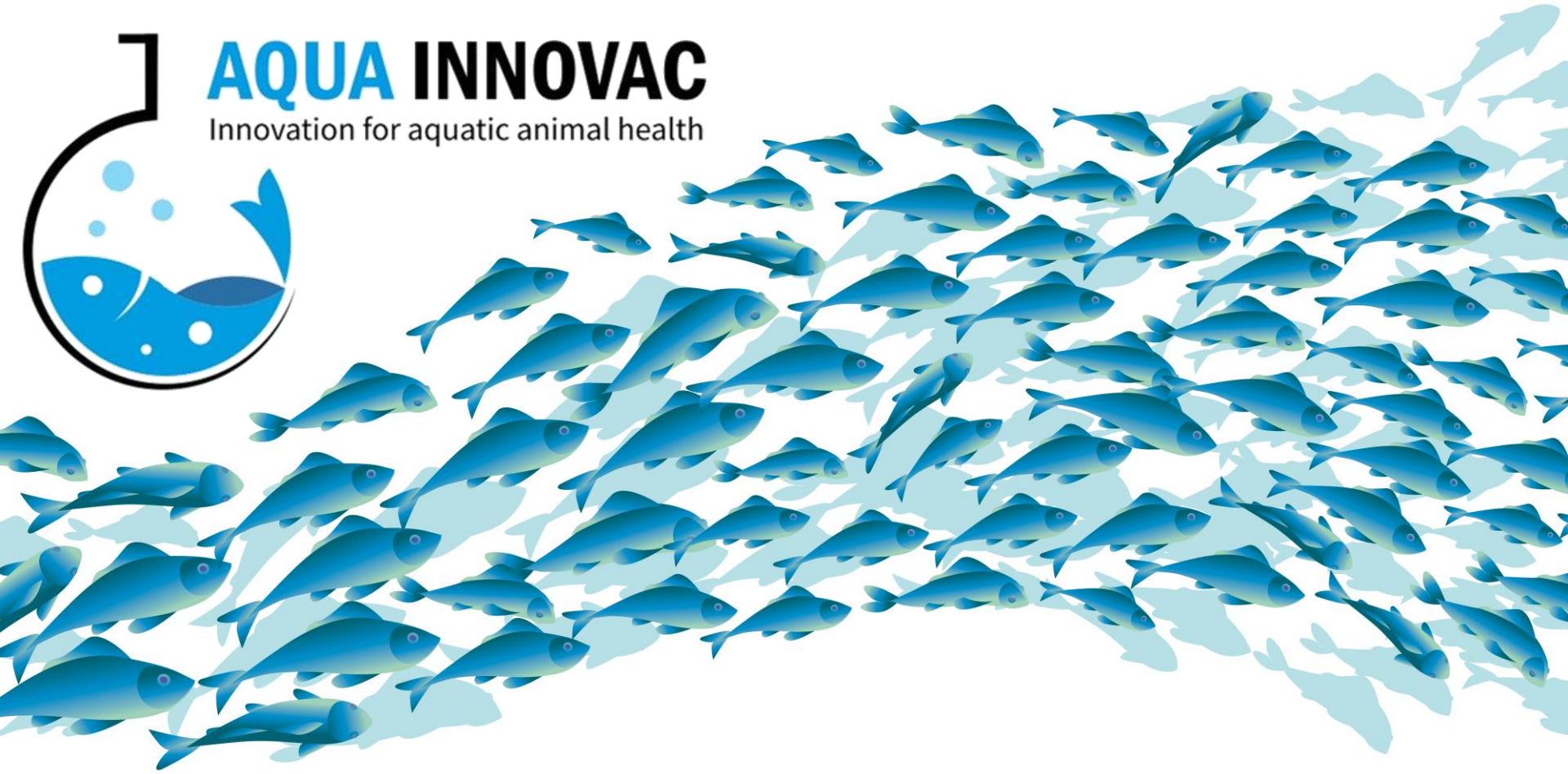

VETERINARY SCIENCE
CHULALONGKORN UNIVERSITY

รองศาสตราจารย์ น.สพ. ดร. ชาญณรงค์ รอดคำ

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Founder & Chief Executive Officer (CEO)

Tokyo University of Marine Science and Technology

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Pillar of the Kingdom

2005 Tokyo University of Marine science and Technology
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1997 CHULALONGKORN UNIVERSITY
Bachelor Degree in Veterinary Science (D.V.M) Second Class honors. Faculty of Veterinary Science

AQUA INNOVAC
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Imperial College London

Imperial College London

CHIANG MAI UNIVERSITY

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2009 – 2010 IMPERIAL COLLEGE LONDON
Master of Science (MSc) in Molecular Medicine
2004 – 2007 CHIANG MAI UNIVERSITY
Bachelor of Science (BSc) in Biology (a gold medal award and first-class honor

ผู้เชี่ยวชาญ/ที่ปรึกษา
(EXPERT/ADVISOR)

รศ. น.สพ. ดร. นพดล พิศารัตน์

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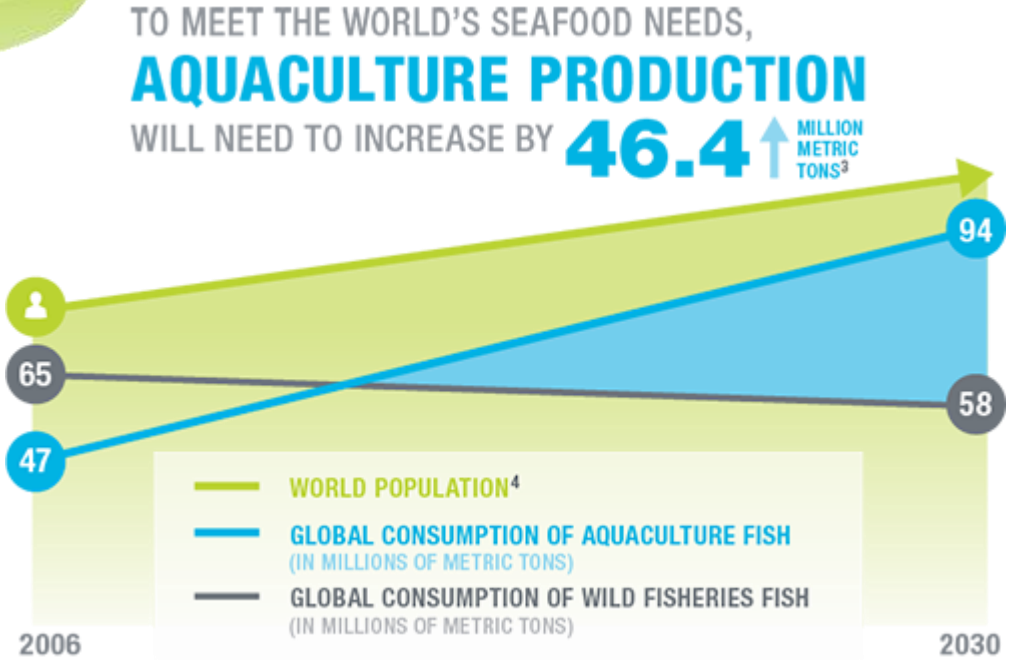
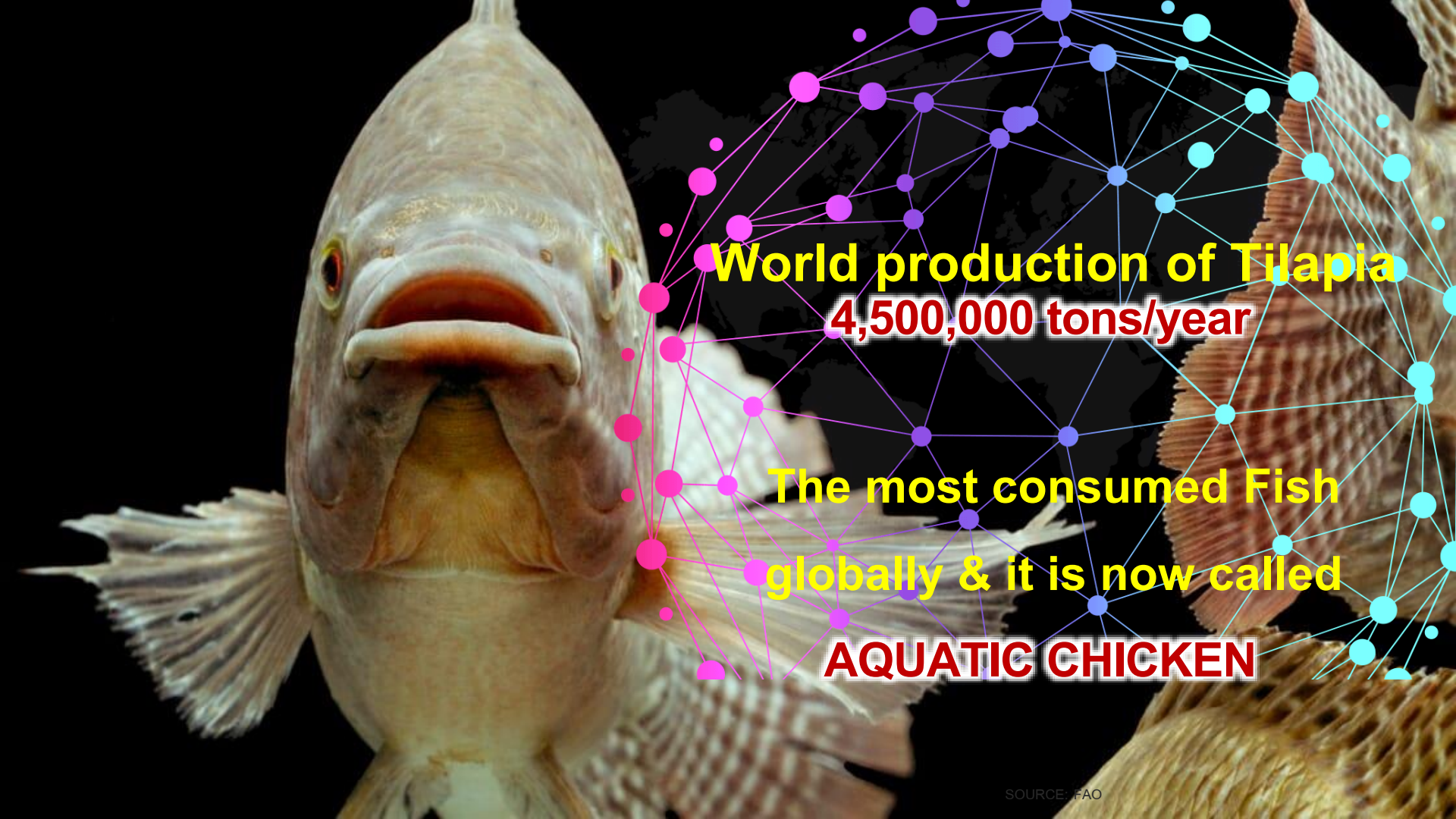
CHULALONGKORN UNIVERSITY
Doctor of Philosophy in Veterinary Pathobiology, Faculty of Veterinary Science
CHULALONGKORN UNIVERSITY
Bachelor Degree in Veterinary Science (D.V.M) Faculty of Veterinary Science

TEAM MEMBERS

- An estimated 73-180 billion fish are farmed each year – making them the most farmed vertebrate in the world.
- Higher fish welfare means **better lives for billions of fish**, on farms



YIELD FROM FRESHWATER AQUACULTURE BY SPECIES (Department of Fisheries, Thailand)


World production of Tilapia
4,500,000 tons/year
The most consumed Fish
globally & it is now called
AQUATIC CHICKEN
SOURCE: FAO

AQUACULTURE PRODUCTION AND PROBLEMS

- Intensive production is undoubtedly threatened by the potential devastation of infectious diseases
- Major infectious pathogens:
  - *Streptococcus agalactiae, S. iniae*
  - *Flavobacterium columnare*
  - *Aeromonas spp. (A. veronii, A.schubertii, etc.)*
  - *Francisella noatunensis* subsp. *orientalis*
  - *Edwardsiella* spp. (*E. tarda* & *E. ictaluri*)
  - *Mycobacterium marinum*
  - *Iridovirus*
  - *TiLV*
  - *TiPV*

Major bacterial diseases in Tilapia

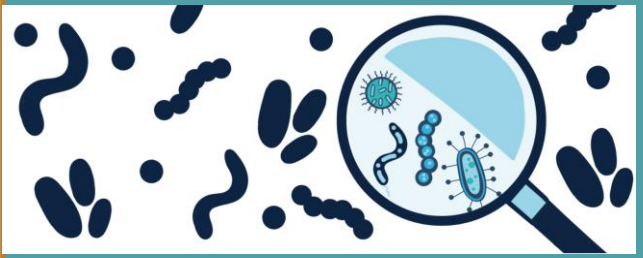
Streptococcosis

Francisellosis

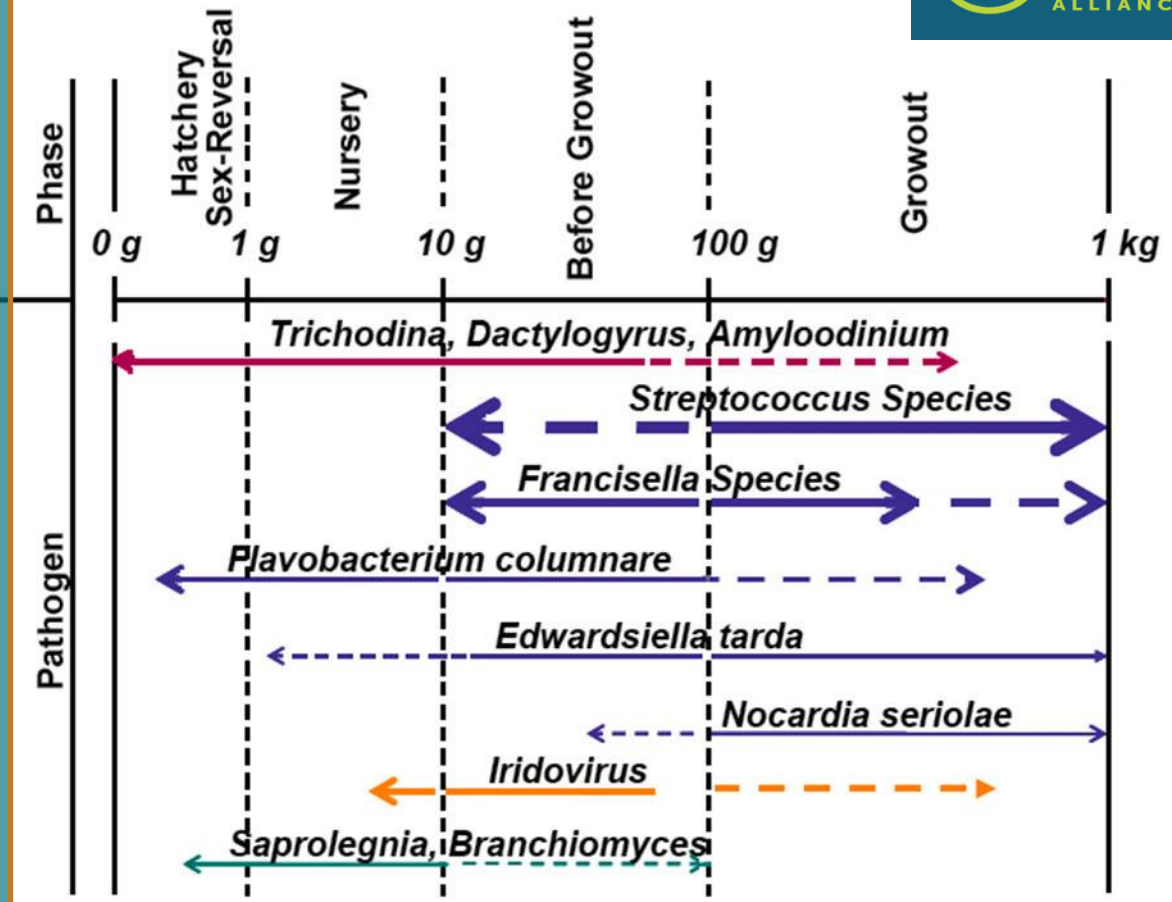
Columnaris

Hemorrhage

Major diseases affecting tilapia during the farming cycle



Major bacteria that affect tilapia include *S. agalactiae, S. iniae, F.columnare* and *Francisella* species.



Common problems found in all journeys

- Infectious diseases
- Ineffective of old solutions used (reduce mortalilty only -10-20 %)
- Lack of standard diagnostic services
- Lack of services from Veterinarians or Expert
- Lack of effective vaccines
- Antibiotics resistance bacteria
- Antibiotic residues
- Hameful for consumers and environments
- Poor food safety and security

Our customers and journey

- กลุ่มผู้ผลิตลูกพันธุ์ปลาเพื่อจำหน่ายให้เกษตรกรนำไปเลี้ยงต่อ
- กลุ่มผู้เลี้ยงปลาระยะอนุบาล
- กลุ่มผู้เลี้ยงปลาระยะขุนจนถึงส่งตลาด

User journey and Our Journey

Fish farm
- ❑ Infectious diseases
- ❑ high morality 70-100 %
- ❑ No effective solutions to solve problems
- ❑ No vaccine commercially available
- ❑ Economic loss
- ❑ Poor quality of farmer life

Old solution
- ❑ Antibiotics
- ❑ Chemical (KMnO4, Salt)
- ❑ Feed additives
- ❑ Immunostimulants (non-specific prevention)
- ❑ Doing nothing

Pain points
- ❑ No effective solutions (reduce mortalilty only -10-20 %)
- ❑ Antibiotics resistance bacteria
- ❑ Antibiotic residues
- ❑ Harmful for consumers and environments
- ❑ Poor food safety and security

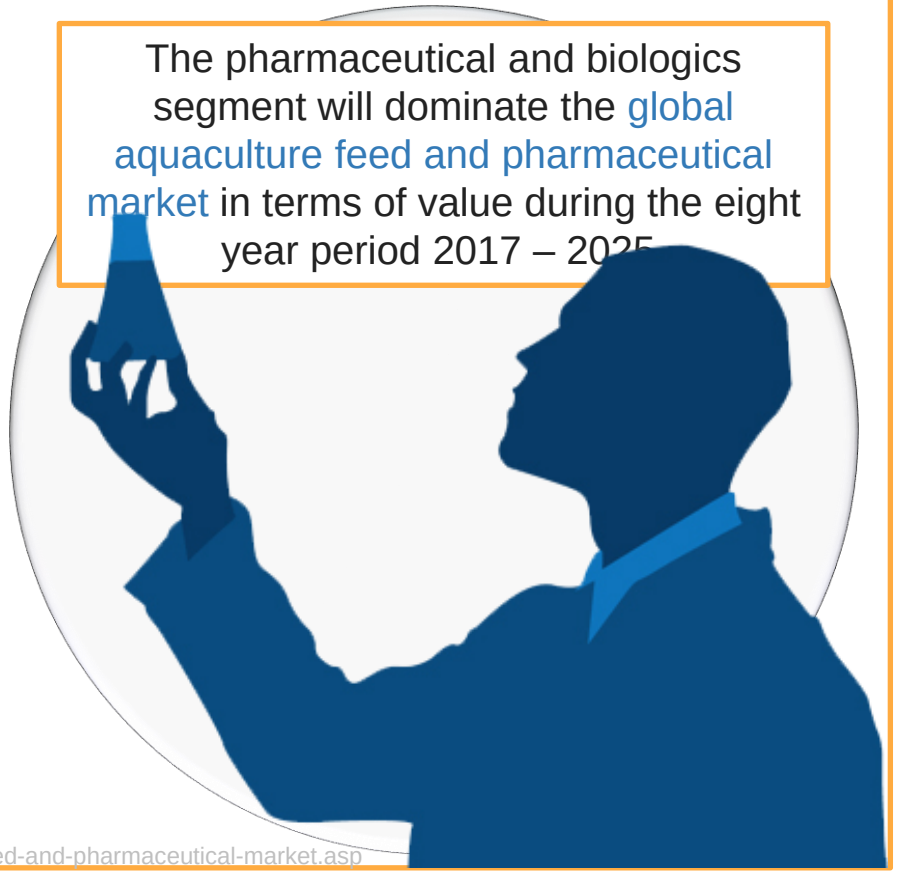
New solution
- ❑ High efficacy mucoadhesive nano vaccine
- ❑ Expert in standard diagnostic tests
- ❑ High experience Veterinary services

Benefits
- ❑ Decrease mortality up to 70 %
- ❑ Food safety
- ❑ Economic impact
- ❑ Happy life farmers
- ❑ Environmental friendly

Global Market Study on Aquaculture Feed and Pharmaceuticals: Pharmaceutical and Biologics Product Type Segment to Dominate the Global Market Through 2025

The global market for aquaculture feed and pharmaceuticals is likely to be influenced by **innovations and research** in **biologics and pharmaceuticals** in the coming years.

The pharmaceutical and biologics segment will dominate the global aquaculture feed and pharmaceutical market in terms of value during the eight year period 2017 – 2025



Reference: https://www.persistencemarketresearch.com/market-research/aquaculture-feed-and-pharmaceutical-market.asp

NEWS

Fish vaccine Market – Industry Analysis, Size, Share, Growth, Trends and Forecast 2018 – 2024

December 2, 2019 7 Min Read

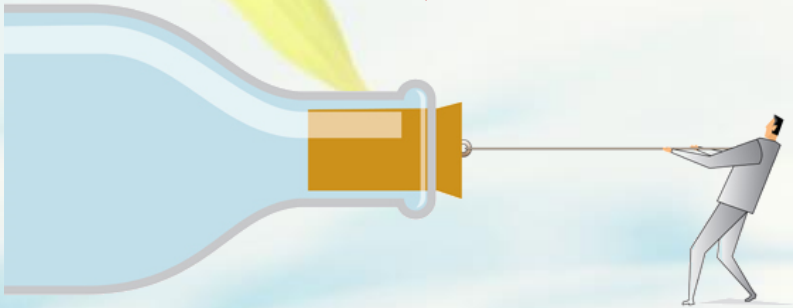
VACCINES FOR FISH

IN AQUACULTURE

Traditional vaccine

Whole inactivated

Live attenuated



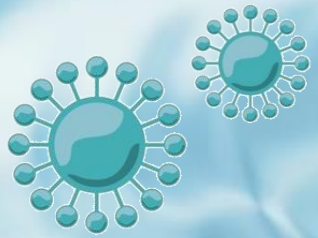
Modern vaccine

Recombinant bacterial vector

Recombinant viral vector

Where to focus next?

FIND THE BOTTLENECK



Synthetic peptides

Recombinant subunit

DNA

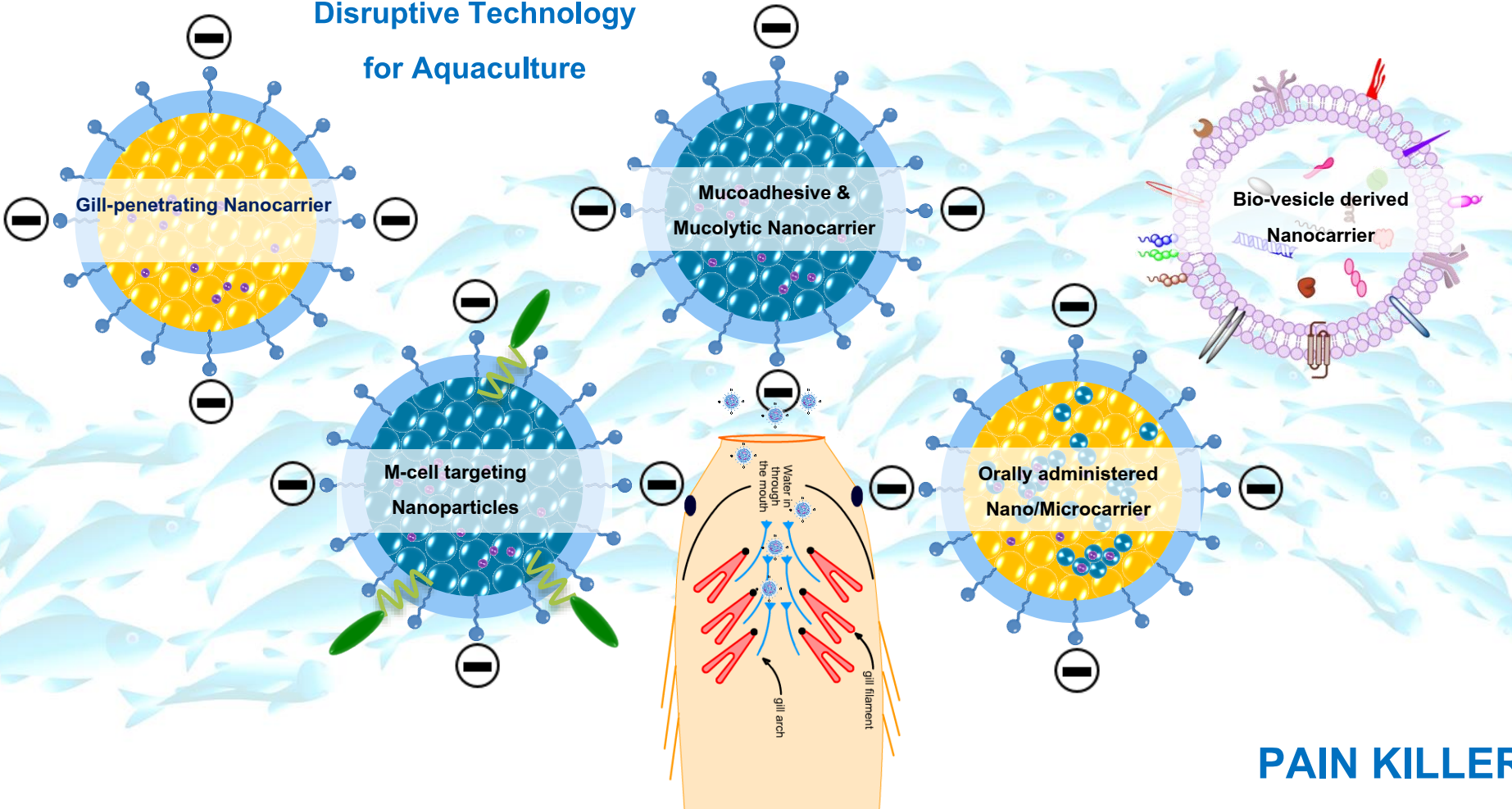

VACCINATION OF
TILAPIA

PAINPOINT OF AVAILABLE VACCINE

ต้นทุนสูง

ประสิทธิภาพต่ำ
ราคาแพง
ใช้แรงงานมาก
สิ้นเปลืองเวลา
ปลาบอบช้ำ

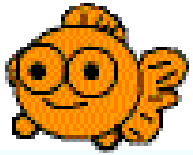
Disruptive Technology for Aquaculture



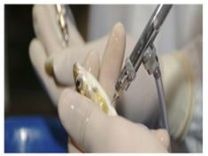
PAIN KILLER

FLAVO INNOVAC

THE NEW SOLUTION FOR FISH VACCINATION

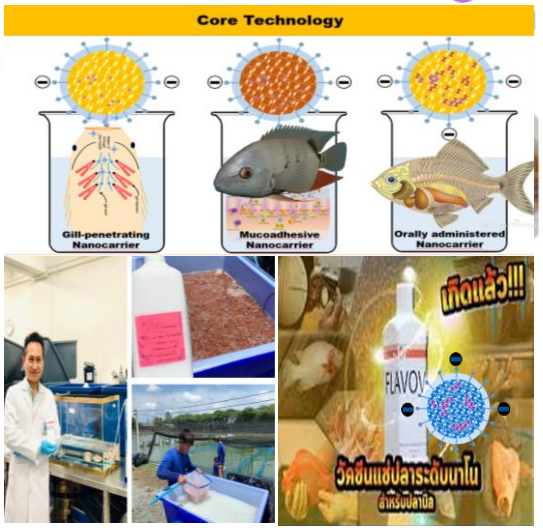


- ☹ Fish production losses 70 % from bacterial diseases
- ☹ No effective solutions
- ☹ Economic loss
- ☹ Antibiotic resistance Bacteria
- ☹ Antibiotic residue
- ☹ No food safety and security



Old solution

- ☹ Injection vaccine
- ☹ Difficult to manipulate large fish numbers
- ☹ Time consume
- ☹ Low immune response
- ☹ High price vaccine



New solution

- ☺ Nano delivery system
- ☺ Farmer friendly, easy way
- ☺ Fish survival rate > 90 %
- ☺ Improve production efficiency
- ☺ Better return on investments
- ☺ Farm economic sustainability

Vaccinate with FLAVO INNOVAC

FLAVO INNOVAC® is an immersion vaccine for tilapia that is indicated to reduce mortality and disease development due to *Flavobacterium columnare*.

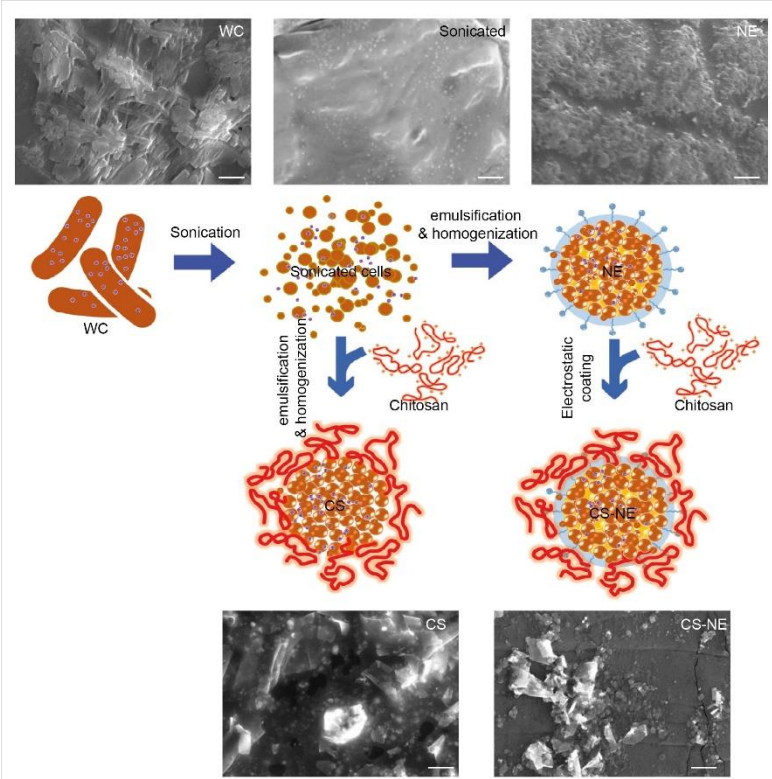
AQUA INNOVAC
Innovation for aquatic animal health

FLAVO INNOVAC
วัคซีนป้องกันปลาจากแบคทีเรีย
ความภูมิใจของนักวิจัยไทย
EaRtH Channarong Rodkhum 098-9052888

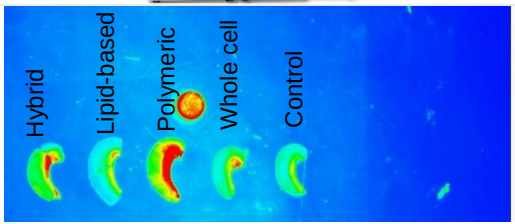
วัคซีนปลาFLAVO INNOVAC
ปกป้องปลาจาก
โรคเหงือกเน่า ตัวด่าง

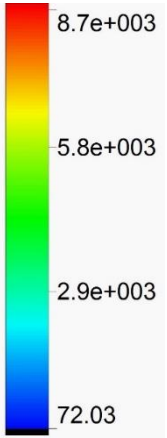
วัคซีนนาโนแบบแช่ต้านโรคเหงือกเน่าในปลา
นวัตกรรมที่ช่วยเพิ่มอัตราการรอดชีวิตให้ปลา

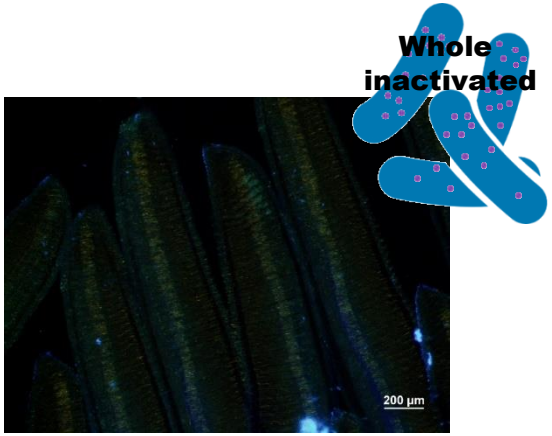
โรคเหงือกเน่า ปัญหาโรคปลาในอุตสาหกรรมเลี้ยงปลา เกิดจากการติดเชื้อแบคทีเรีย หากโรคเหงือกเน่าระบาดทำให้เกิดการสูญเสียปลาได้มากถึง 80-90% (เหงือกเปรียบเสมือนปอดของปลา)

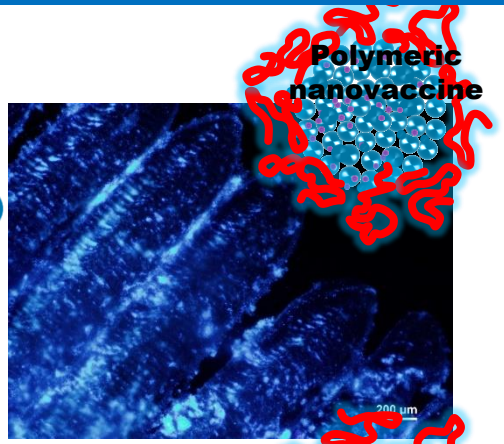


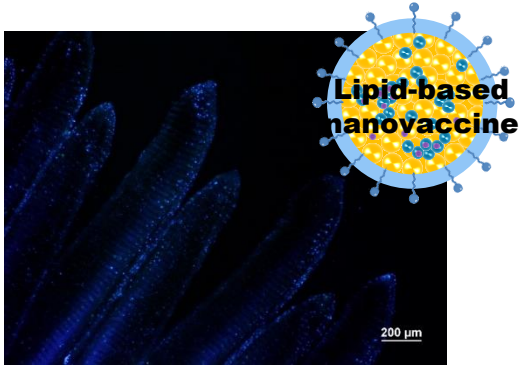
เทคโนโลยีเกาะติดเยื่อเมือก
ด้วยอนุภาคนาโนดัดแปลงพื้นผิวด้วยโพลีเมอร์

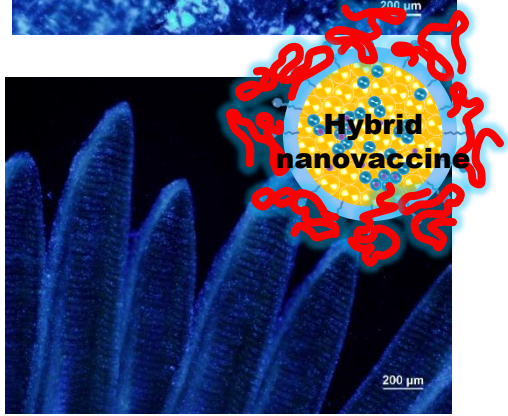




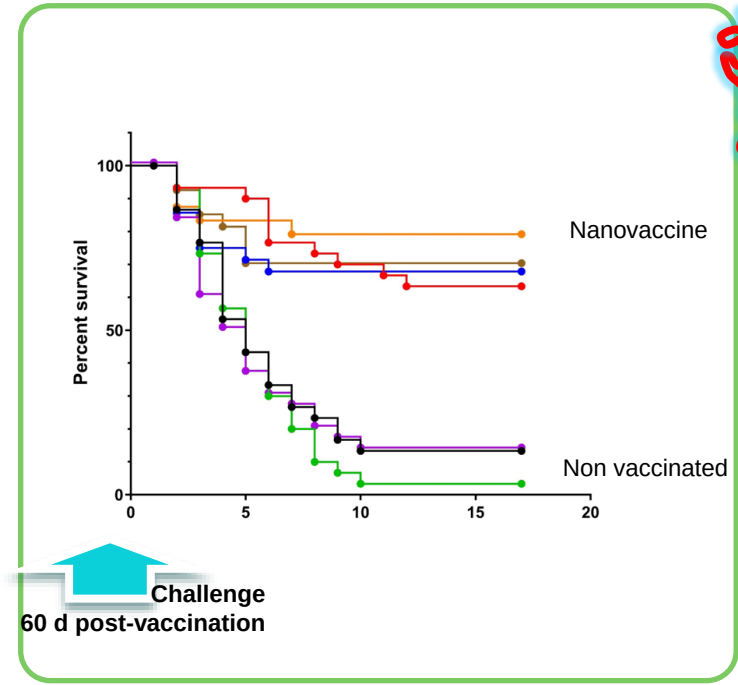


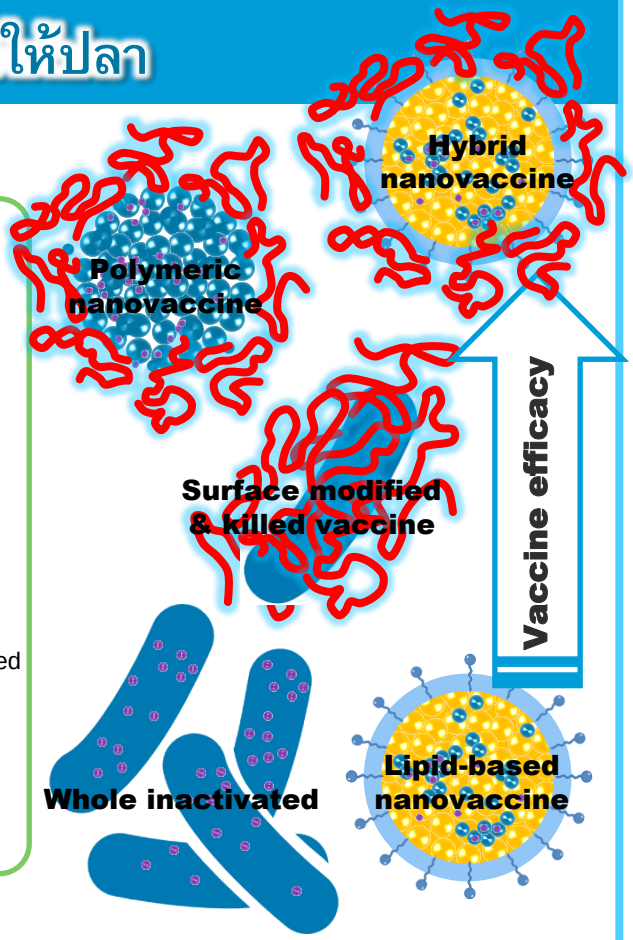






วัคซีนนาโนแบบแช่ต้านโรคเหงือกเน่าในปลา
นวัตกรรมที่ช่วยเพิ่มอัตราการรอดชีวิตให้ปลา





การทดสอบความปลอดภัยและประสิทธิภาพในระดับภาคสนามของนาโนวัคซีนที่มีคุณสมบัติเกาะติดเยื่อเมือกในปลานิล (แบบจุ่ม) เพื่อควบคุมโรคติดเชื้อฟลาโวแบคทีเรียม คอลัมแนร์

(Evaluation of Safety and Efficacy of Mucoadhesive Nanovaccine (Immersion vaccination) against *Flavobacterium columnare* in Farmed Tilapia)

How to use our product

AQUA INNOVAC
Innovation for aquatic animal health

Type of vaccine :
Killed bacterial cell nano vaccine

Indication :
1.Mix 500 ml. of vaccine with 50 litter of water.
2.Immerse 50,000 freshwater fish
(1–5 gram body weight) for 30 min.
with Do.> 5 and continuously aeration.
3.Release fish to the culture pond

Fish species recommended :
Nile Tilapia (*Oreochromis niloticus*)
Red Tilapia (*Oreochromis sp.*)
Freshwater culture
Asian Sea Bass (*Lates calcarifer*)

for immersion use only

Lot No. .....
Manufacturing date.....
Expiration Date.....

Product of
AQUA INNOVAC, CO., LTD.
No. 39, Faculty of Veterinary Science,
Chulalongkorn University, Bangkok, THAILAND

BATH

IMMERSION VACCINATION

ผลงานตีพิมพ์ในวารสารวิชาการระดับนานาชาติ และผลงานสิทธิบัตร/อนุสิทธิบัตร

Fish and Shellfish Immunology 96 (2019) 635–646

Contents lists available at ScienceDirect

Fish and Shellfish Immunology

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

Full length article

The potential of mucoadhesive polymer in enhancing efficacy of direct immersion vaccination against *Flavobacterium columnare* infection in tilapia

Sirikorn Kitiyodom[a], Somrudee Kaewmalun[b], Naiyaphat Nittayasut[b], Kunat Suktham[b], Suvimol Surassmo[b], Katawut Namdee[c], Channarong Rodkhum[d], Nopadon Pirarat[a,**], Teerapong Yata[a,*]

[a] Wildlife Exotic and Aquatic Pathology-Research Unit, Department of Pathology, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, 10330, Thailand
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ARTICLE INFO

Keywords:
Bath vaccination
Chitosan
Columnaris disease
Tilapia

ABSTRACT

Vaccination is the most effective approach for prevention of infectious diseases in aquaculture. Although immersion vaccination is more applicable compared to in-feed/oral administration and injection, this method suffers from low potency as the efficiency of uptake of antigens through mucosal membranes is limited. In this study, we have successfully developed a mucoadhesive vaccine delivery system to enhance the efficacy of direct immersion vaccination against *Flavobacterium columnare*, the causative agent of columnaris disease in red tilapia. A formalin-killed negatively charged, bacterial cell suspension was used to prepare a mucoadhesive vaccine by electrostatic coating with positively charged chitosan. Our results demonstrate that the chitosan-complexed vaccine greatly increases its mucoadhesiveness, thus increasing the chances of vaccine uptake by the gill mucosa and improving the protection obtained against columnaris infection. The surface charge of the chitosan-complexed vaccine was altered from anionic to cationic after chitosan modification. Tilapia were vaccinated with the prepared chitosan-complexed vaccine by immersion. The challenge test was then carried out 30 and 60 days post vaccination, which resulted in a high level of mortalities in the non-vaccinated and unconplexed vaccine groups. A high relative percentage survival (RPS) of vaccinated fish was noted with the mucoadhesive vaccine. Our results indicated that the naked vaccine failed to protect the fish from columnaris infection, which is consistent with the mucoadhesive assays performed during the study showing that the naked vaccine was unable to bind to mucosal surfaces. This system is therefore an effective method for immersion vaccination in order to deliver the antigen preparation to the mucosal surface membrane of the fish.

1. Introduction

Tilapia (*Oreochromis* sp.) is one of the most important fish species produced in fish farming [1]. Bacterial infection caused by *Flavobacterium columnare*, the causative agent of columnaris disease, has been now identified as one of the most serious infectious diseases in farmed tilapia [2]. *F. columnare* is a Gram-negative, rod and slender filamentous bacterium with gliding motility and yellow rhizoid colony formation [3]. *F. columnare* infections may result in skin lesions, fin rot and gill necrosis, with a high degree of mortality, leading to severe economic losses [4].

It is well established that vaccination is the most effective approach for prevention of infectious diseases in aquaculture [5]. Aquaculture vaccines are roughly administered through major three routes, i.e. bath or immersion, in-feed or oral, and injection [6]. While immersion vaccination is the most applicable mode of delivery of these routes of administration, this method suffers from low potency as the efficiency of antigen uptakes through the gills and skin is limited [7].

Chitosan (CS), sometimes known as deacetylated chitin found in the exoskeletons of crustaceans, is a natural polycationic linear polysaccharide that exhibits mucoadhesive properties [8]. Among polymers, chitosan has been exploited for the design of mucoadhesive dosage

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Fish and Shellfish Immunology 112 (2021) 81–91

Contents lists available at ScienceDirect

Fish and Shellfish Immunology

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

Modulation of the mucosal immune response of red tilapia (*Oreochromis* sp.) against columnaris disease using a biomimetic-mucoadhesive nanovaccine

Sirikorn Kitiyodom[a], Clara Trullàs[a], Channarong Rodkhum[b], Kim D. Thompson[c], Takayuki Katagiri[d], Sasithon Temisak[e], Katawut Namdee[f], Teerapong Yata[g,**], Nopadon Pirarat[a,*]

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[b] Department of Microbiology, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, 10330, Thailand
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[d] Laboratory of Fish Health Management, Course of Aquatic Biosciences, Tokyo University of Marine Science and Technology, Tokyo, Japan
[e] Bio Analysis Group, Chemical Metrology and Biometry Department, National Institute of Metrology (NIMT), Pathum Thani, 12120, Thailand
[f] National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA), Pathum Thani, 12120, Thailand
[g] Biochemistry Unit, Department of Physiology, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, 10330, Thailand

ARTICLE INFO

Keywords:
Red tilapia
Mucosal immunity
MALT
Columnaris disease
Mucoadhesive nano-immersion vaccine

ABSTRACT

Columnaris, a highly contagious bacterial disease caused by *Flavobacterium columnare*, is recognized as one of the most important infectious diseases in farmed tilapia, especially during the fry and fingerling stages of production. The disease is associated with characteristic lesions in the mucosa of affected fish, particularly their skin and gills. Vaccines delivered via the mucosa are therefore of great interest to scientists developing vaccines for this disease. In the present study, we characterized field isolates of *F. columnare* obtained from clinical columnaris outbreaks in red tilapia to select an isolate to use as a candidate for our vaccine study. This included characterizing its colony morphology, genotype and virulence status. The isolate was incorporated into a mucoadhesive polymer chitosan-complexed nanovaccine (CS-NE), the efficacy of which was determined by experimentally infecting red tilapia that had been vaccinated with the nanoparticles by immersion. The experimental infection was performed 30-days post-vaccination (dpv), which resulted in 80% of the unvaccinated control fish dying, while the relative percentage survival (RPS) of the CS-NE vaccinated group was 78%. Histology of the mucosal associated lymphoid tissue (MALT) showed a significantly higher presence of leucocytes and a greater antigen uptake by the mucosal epithelium in CS-NE vaccinated fish compared to control fish and whole cell vaccinated fish, respectively, and there was statistically significant up-regulation of *IgT, IgM, TNF α, IL1-β* and *MHC I* genes in the gill of the CS-NE vaccinated group. Overall, the results of our study confirmed that the CS-NE particles achieved better adsorption onto the mucosal surfaces of the fish, elicited great vaccine efficacy and modulated the MALT immune response better than the conventional whole cell-killed vaccine, demonstrating the feasibility of the mucoadhesive nano-immersion vaccine as an effective delivery system for the induction of a mucosal immune response against columnaris disease in tilapia.

1. Introduction

Tilapia (*Oreochromis* sp.) is an important freshwater fish for global aquaculture. As tilapia culture has expanded, there has been an increasing trend for intensification of the production system, resulting in overcrowding of stock. This, together with other factors, such as climate change and poor farm management, have increased its susceptibility to bacterial infections. *Flavobacterium columnare*, the causative agent of columnaris disease, has been characterized as one of the most serious infectious bacterial diseases in farmed tilapia [1]. This pathogen is a

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Full length article

Enhanced efficacy of immersion vaccination in tilapia against columnaris disease by chitosan-coated "pathogen-like" mucoadhesive nanovaccines

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Immersion vaccination
Chitosan
Columnaris disease
Tilapia

ABSTRACT

Red tilapia (*Oreochromis* sp.) has become one of the most important fish in aquaculture. Bacterial infection caused by *Flavobacterium columnare*, the causative agent of columnaris disease, has been now identified as one of the most serious infectious diseases in farmed red tilapia and cause major financial damage to the producers. Among the effective prevention and control strategies, vaccination is one of the most effective approach. As the surface of living fish is covered by mucus and directly associated with the mucosal immunity, we therefore hypothesized that better adsorption on mucosal surfaces and more efficient vaccine efficacy could be enhanced biomimetic nanoparticles mimicking the mucoadhesive characteristic of live *F. columnare*. In this work, we describe an effective approach to targeted antigen delivery by coating the surface of nanoparticles with mucoadhesive chitosan biopolymer to provide "pathogen-like" properties that ensure nanoparticles binding on fish mucosal membrane. The physiochemical properties of nanovaccines were analyzed, and their mucoadhesive characteristics and immune response against pathogens were also evaluated. The prepared vaccines were nanosized and monodispersal as confirmed by scanning electron microscope (SEM). The analysis of hydrodynamic diameter and zeta-potential also suggested the successful modification of nanovaccines by chitosan as indicated by positively charged and the overall increased diameter of chitosan-modified nanovaccines. *In vivo* mucoadhesive study demonstrated the excellent affinity of the chitosan-modified nanovaccines toward fish gills as confirmed by bioluminescence imaging, fluorescent microscopy, and spectrophotometric quantitative measurement. Following vaccination with the prepared nanovaccines by immersion 30 min, the challenge test was then carried out 30 and 60 days post-vaccination and resulted in high mortalities in the control. The relative percent survival (RPS) of vaccinated fish was greater than 60% for mucoadhesive nanovaccine. Our results also suggested that whole-cell vaccines failed to protect fish from columnaris infection, which is consistent with the mucoadhesive assays showing that whole-cell bacteria were unable to bind to mucosal surfaces. In conclusion, we could use this system to deliver antigen preparation to the mucosal membrane of tilapia and obtained a significant increase in survival compared to controls, suggesting that targeting mucoadhesive nanovaccines to the mucosal surface could be exploited as an effective method for immersion vaccination.

1. Introduction

According to 2015 UN Food and Agriculture Organization (GLOBEFISH - Analysis and information on world fish trade), Nile tilapia (*Oreochromis niloticus*) and red tilapia (*Oreochromis* sp.) have increasingly recognized as one of the most important freshwater fish in aquaculture. Inevitably, several bacterial diseases can cause major financial damage to the producers of tilapia. Bacterial infection caused by *Flavobacterium columnare*, the causative agent of columnaris disease, has been now identified as one of the most serious infectious diseases in farmed tilapia [1]. *F. columnare* are gram negative, rod and slender filamentous bacterium with gliding motility and yellow rhizoid colony

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Intellectual Property Protection

- Patents pending (National)


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☐ อนุสิทธิบัตร

1.ชื่อที่แสดงถึงการประดิษฐ์/การออกแบบผลิตภัณฑ์

องค์ประกอบนาโนวัคซีนต่อต้านเชื้อฟลาโวแบคทีเรียมคอลัมนาริสในปลา และกรรมวิธีการเตรียมนาโนวัคซีนดังกล่าว

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วันรับคำขอ 26 ก.ย. 2561

วันยื่นคำขอ 26 ก.ย. 2561

เลขที่คำขอ 1801005882

ชื่อ จุฬาลงกรณ์มหาวิทยาลัย

ที่อยู่ 254 ถนนพญาไท

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3.2 โทรศัพท์ 02-218-4195-7

3.3 โทรสาร 02-218-4198

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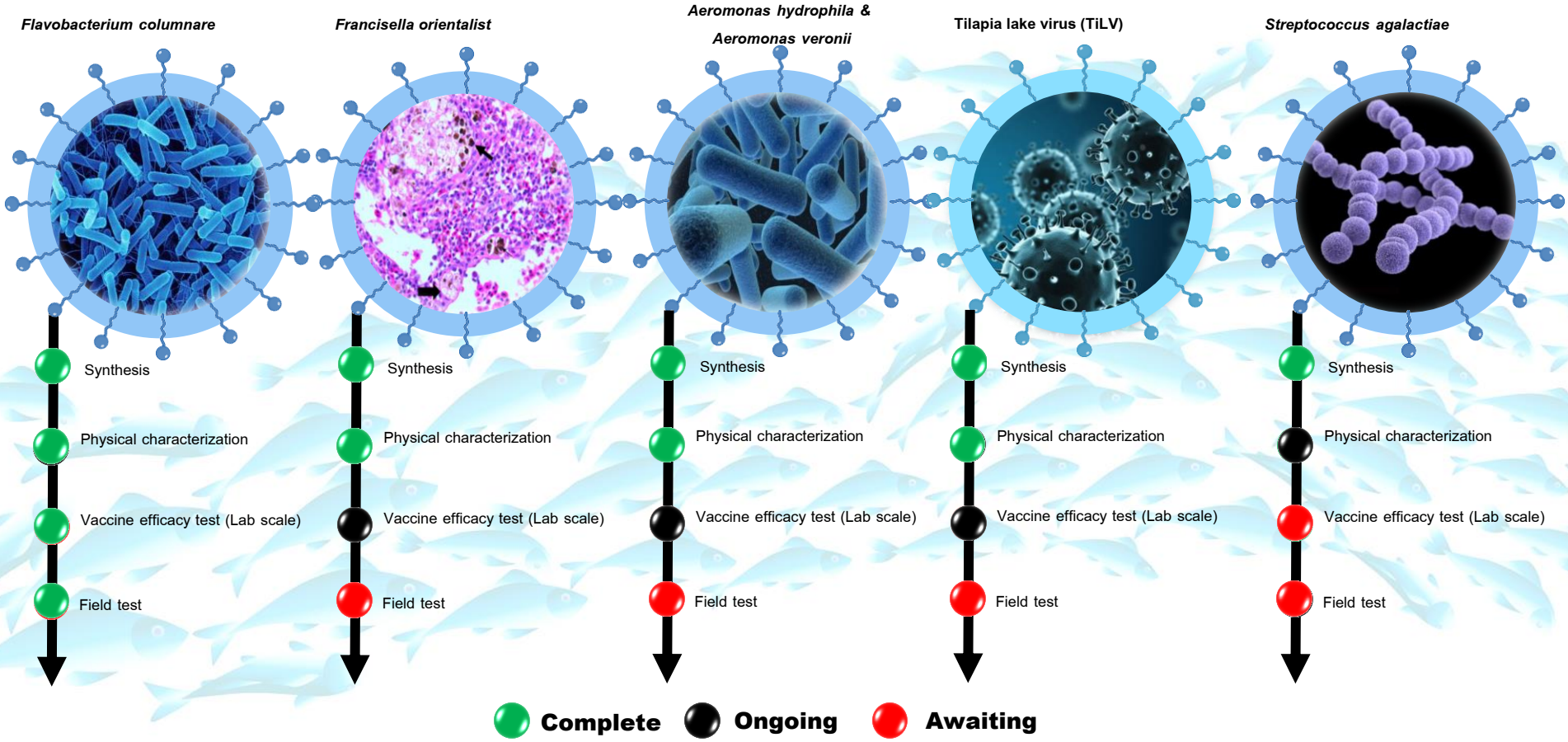
ที่อยู่ คณะสัตวแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ถนนพญาไท


Flavobacterium columnare
Synthesis
Physical characterization
Vaccine efficacy test (Lab scale)
Field test
Francisella orientalist
Synthesis
Physical characterization
Vaccine efficacy test (Lab scale)
Field test
Aeromonas hydrophila &
Aeromonas veronii
Synthesis
Physical characterization
Vaccine efficacy test (Lab scale)
Field test
Tilapia lake virus (TiLV)
Synthesis
Physical characterization
Vaccine efficacy test (Lab scale)
Field test
Streptococcus agalactiae
Synthesis
Physical characterization
Vaccine efficacy test (Lab scale)
Field test
Complete
Ongoing
Awaiting

Final MVP Envisioned

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Innovation for aquatic animal health

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AQUA INNOVAC CO., LTD.
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INNOVATION FOR AQUATIC ANIMAL HEALTH

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(AQUA-Health Checkup)

We provides health screening and diagnostic testing for fresh water and marine fish, including ornamental species.

วัคซีนสัตว์น้ำ

(AQUA-Vac)

We provides vaccines against fish diseases caused by bacteria and viruses through nanotechnology-based immersion & oral vaccines.

ผลิตภัณฑ์สัตว์น้ำ

(AQUA-Products)

We have a range of "**value-added**" **products** by using **nanocarriers specifically developed for aquatic animals**

ตรวจสุขภาพสัตว์น้ำ
(AQUA-Health Checkup)

We offers a wide variety of tests for health screening/inspection and diagnostic purposes, allowing our customers to be able to complete all testing in one place, i.e. virology, microbiology , parasitology, pathology, & molecular diagnostics.

การตรวจทางห้องปฏิบัติการ
บริษัท อะควา อินโนแวค

(ตรวจตามวิธีการมาตรฐานขององค์การโรคระบาดสัตว์ระหว่างประเทศ (World Organization for Animal Health หรือ Office International des Epizooties, OIE)

1. ตรวจหาเชื้อแบคทีเรียระบุชนิด
   - Aeromonas spp.
   - Flavobactetium columnare
   - Streptococcus spp.
   - Franciscella spp.
2. ตรวจหาความไวรับของเชื้อแบคทีเรียต่อยาปฏิชีวนะ
3. ตรวจไวรัสหรือแบคทีเรียด้วยวิธี PCR.

นอกจากนี้ยังมีการให้บริการเกี่ยวกับการวางโครงสร้างพื้นฐานเพื่อจัดตั้งห้องปฏิบัติการโรคติดเชื้อของสัตว์น้ำมาตรฐาน สนใจสอบถามข้อมูลเพิ่มเติมได้ที่ บริษัท อะควา อินโนแวค จำกัด

- โภชนเภสัชภัณฑ์และอาหารฟังก์ชันสำหรับสัตว์น้ำ
- สารควบคุมการเคลื่อนไหวสัตว์น้ำ
- ฯลฯ

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We can help your fish farming operation

achieve sustainable performance

with our uniquely effective range of

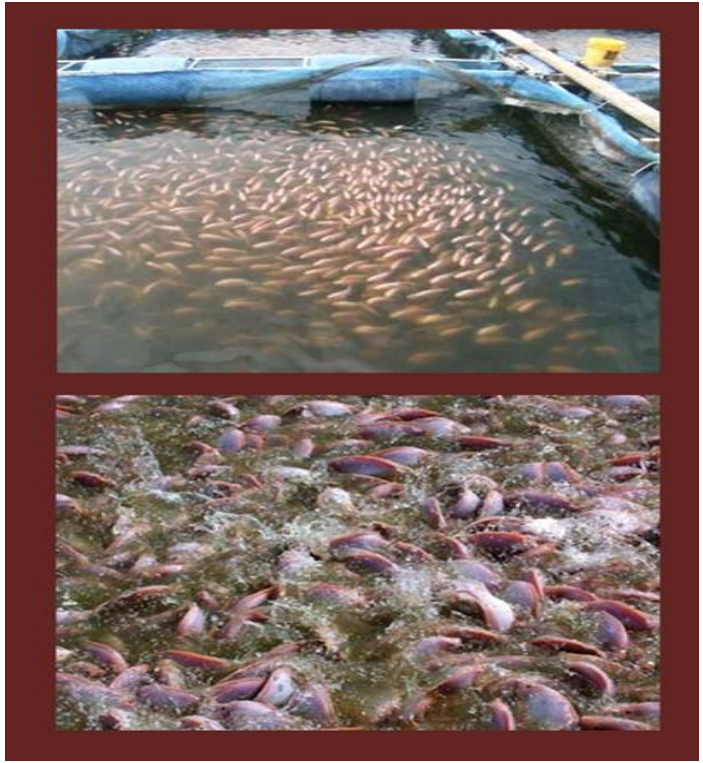
THERANOSTIC

(Diagnosis and Therapy)

PLATFORMS

Products and Technology Users

- Fish breeders
- Fingerling fish distributor
- Fish farmers
- Local Fish vaccine company
- Global Fish Vaccine company



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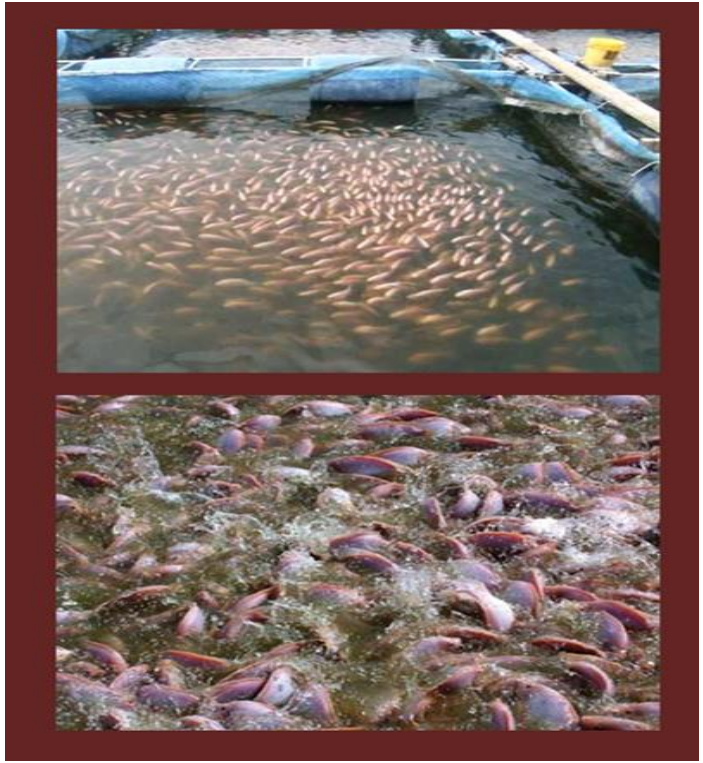

Functional for innovation

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Chulalongkorn University

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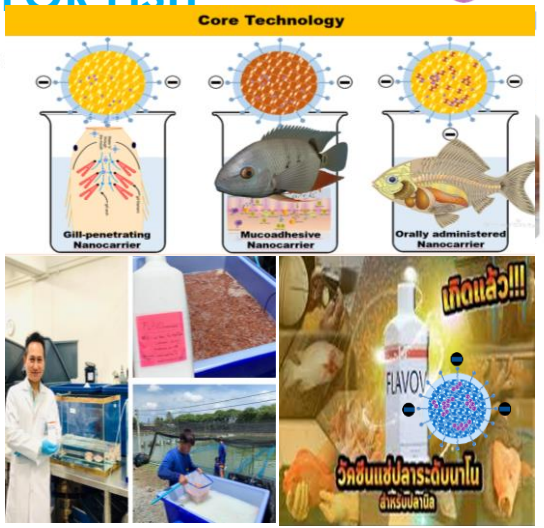
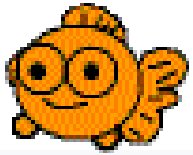
THE NEW SOLUTION FOR FISH

UNIVERSITY TECHNOLOGY CENTER





- ☹ Fish production losses (high morality 70-100 %)
- ☹ No effective solutions to solve problems
- ☹ No vaccine commercially available
- ☹ Economic loss
- ☹ Poor quality of farmer life

Old solution

- ☹ Drug and chemicals
- ☹ Immunostimulants (not direct effect)
- ☹ Antibiotics resistance bacteria
- ☹ Antibiotic residues
- ☹ Poor food safety and security

New solution

- ☺ Nano delivery system
- ☺ Farmer friendly, easy way
- ☺ Fish survival rate > 90 %
- ☺ Improve production efficiency
- ☺ Better return on investments
- ☺ Farm economic sustainability

CURRENTLY AVAILABLE BIOLOGICS FOR FISH

The following is a list of currently available biologics for use in aquatic animals in the United States, with an active license status. This list includes the True Name of the product, the Product Code, and the approved species for the product.

Elanco U.S. Inc., U.S. Veterinary Permittee No. 303A, 1447 140th Street, Larchwood, IA 51241-9778

- Aeromonas Salmonicida Bacterin, Product Code 2035.02, for use in Koi carp (*Cyprinus carpio*), and salmonids
- Arthrobacter Vaccine, Live Culture, Product Code 1K11.00, for use in salmonids
- Aeromonas Salmonicida-Vibrio Anguillarum-Ordalii-Salmonicida Bacterin, Product Code 2138.02, for use in salmonids
- Infectious Salmon Anemia Virus Vaccine, Killed Virus, Aeromonas Salmonicida-Vibrio Anguillarum-Ordalii-Salmonicida Bacterin, Product Code 4A45.20, for use in salmonids
- Yersinia Ruckeri Bacterin, Product Code 2638.00, for use in salmonids
- Infectious Hematopoietic Necrosis Virus Vaccine, DNA, Product Code 17A5.D0, for use in salmonids

INTERVET INC., U.S. Veterinary License No. 165A, 21401 West Center Road, Elkhorn, NE 68022-2202

- Edwardsiella Ictalurii Vaccine, Avirulent Live Culture, Product Code 1531.00, for use in catfish
- Flavobacterium Columnare Vaccine, Avirulent Live Culture, Product Code 17F1.00, for use in catfish

BOEHRINGER INGLEHEIM VETMEDICA, INC., U.S. Veterinary License No. 124, 2621 North Belt Highway, St. Joseph, MO 64506-2002

- West Nile Virus Vaccine, Killed Virus, Product Code 1995.22, for use in alligators

Last updated August 30, 2016

Market sizing estimates

	(Vaccine products)	(Diagnostic services)
TAM	บริษัทผู้ผลิตวัคซีน ผู้ผลิตลูกพันธุ์ปลาจำหน่าย เกษตรกรผู้เลี้ยงปลา	ผู้ผลิตลูกพันธุ์ปลาจำหน่าย เกษตรกรผู้เลี้ยงปลา หน่วยราชการเช่น กรมประมง
SAM	ผู้ผลิตลูกพันธุ์ปลาจำหน่าย เกษตรกรผู้เลี้ยงปลา	ผู้ผลิตลูกพันธุ์ปลาจำหน่าย เกษตรกรผู้เลี้ยงปลา หน่วยราชการเช่น กรมประมง
SOM	Global fish vaccine market to 2025 = 480 USD Mn	Company diagnostic center
Estimated annual revenue	432,000 / farm / year Total 21.6 Mb / year	50,000 THB./ month (100 samples) 6,000,000 THB/ year (1200 samples)

TAM = ตลาดทั้งหมดที่ใช้สินค้าหรือบริการนั้น

SAM = ตลาดที่เราเอื้อมถึงถ้ามีเราคนเดียว

SOM = ความเป็นจริง ตลาดที่เราขอเข้าไปแบ่ง

Revenue Model

Mucosal adhesive nano vaccine (Immersion vaccine)

- *Flavobacterium columnare*
- *Aeromonas veronii*
- *Aeromonas schubertii*
- *Franciscella noatunensis*
- *Virus*

- Vaccine cost = 5,000 THB / litter
- Vaccine selling price = 10,000 THB / litter
- Benefit = 6,000 THB / litter
- 1 litter of vaccine for 100,000 fish (size 1 gram bw)
- 1 farm usually use at least 600,000 fish / 1 turn (use 6 litters of vaccine / turn)
- At least 1 turn / month (Benefit 36,000 THB./ farm)

Assistance required

- ☑ Grants support for research and innovation
- ☑ Collaborations
- ☑ Vaccine license (National and International)
- ☑ Commercial scale production (Vaccine plant)
- ☑ Aquaculture Vaccine and Innovation Center

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