XIV FENACAM
15 DE NOVEMBRO DE 2017
CENTRO DE CONVENÇÕES DE NATAL

An update on research using nutrition to improve health in aquaculture

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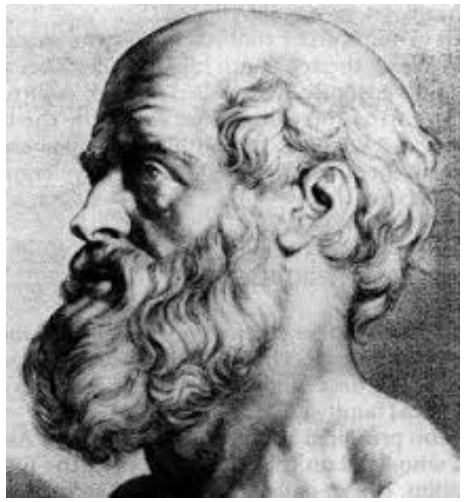
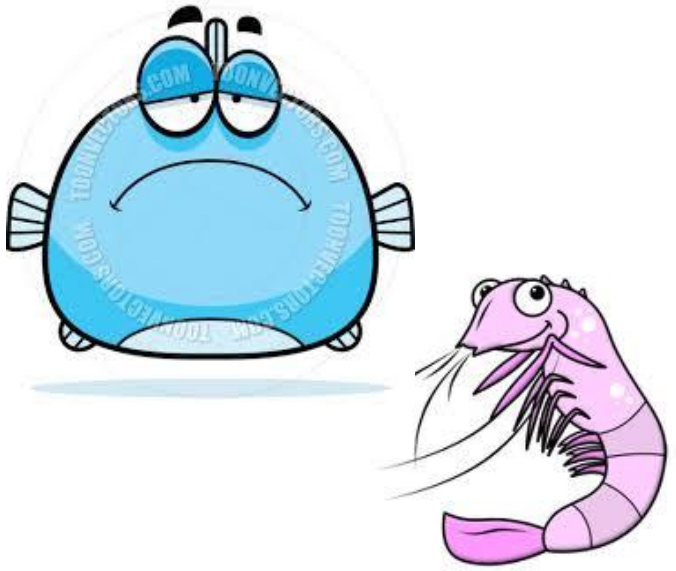
BIOIBERICA



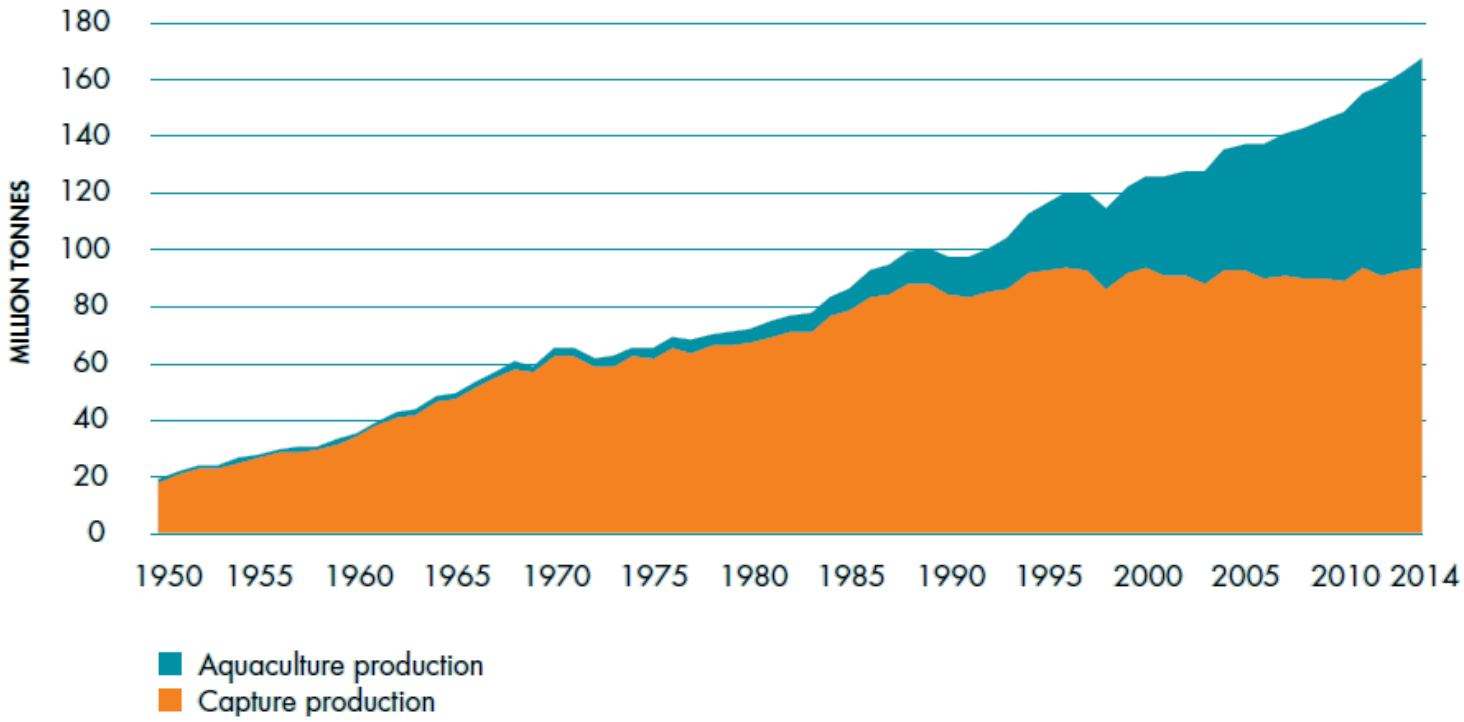
“Let food be the medicine”

Hipocrates from Cos



Let the food be their medicine … too !

Introduction:

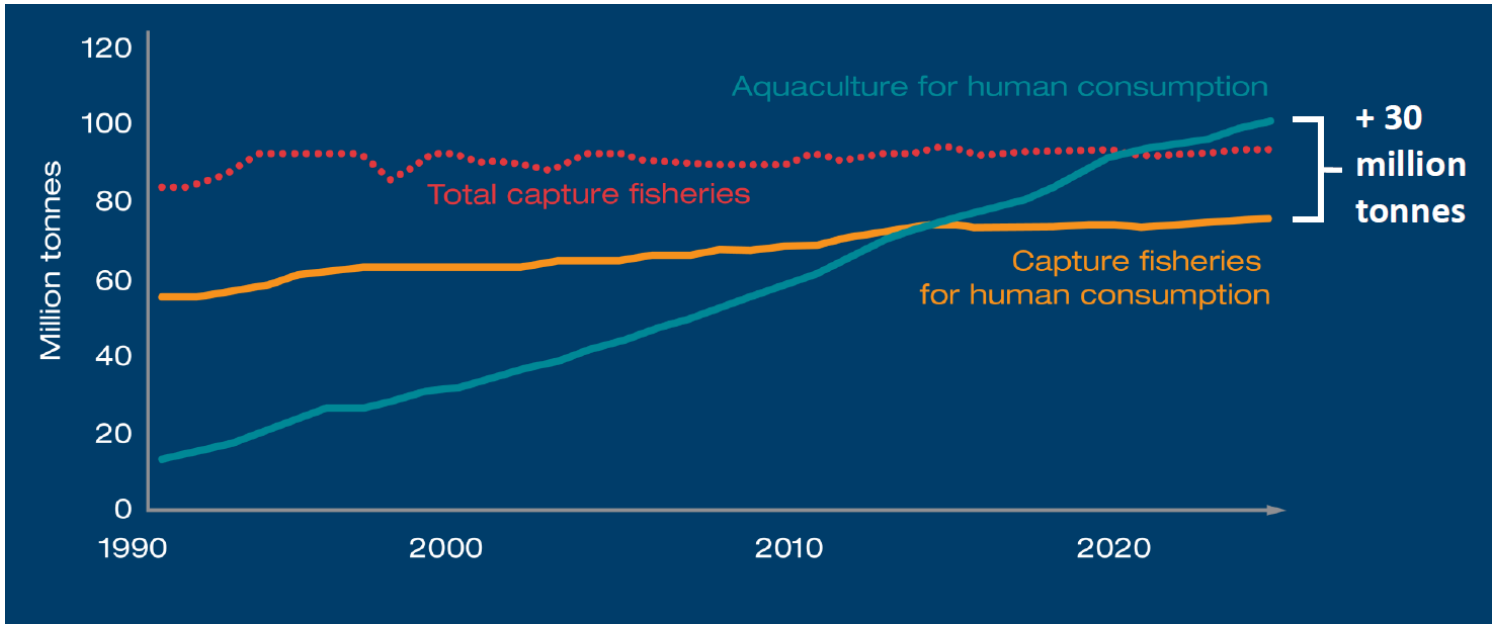


Source: FAO 2016. The State of World Fisheries and Aquaculture

Introduction:

- **World aquaculture** production continues to grow and **now provides half of all fish for human consumption**

- How will we be able to feed **9+ billion people in 2050?? → <u>Role of aquaculture</u>**



Source: A.Obach CNA Ponencia Inaugural AOB Sept 2017 final

Introduction:

- **Current <u>CHALLENGES</u>:**

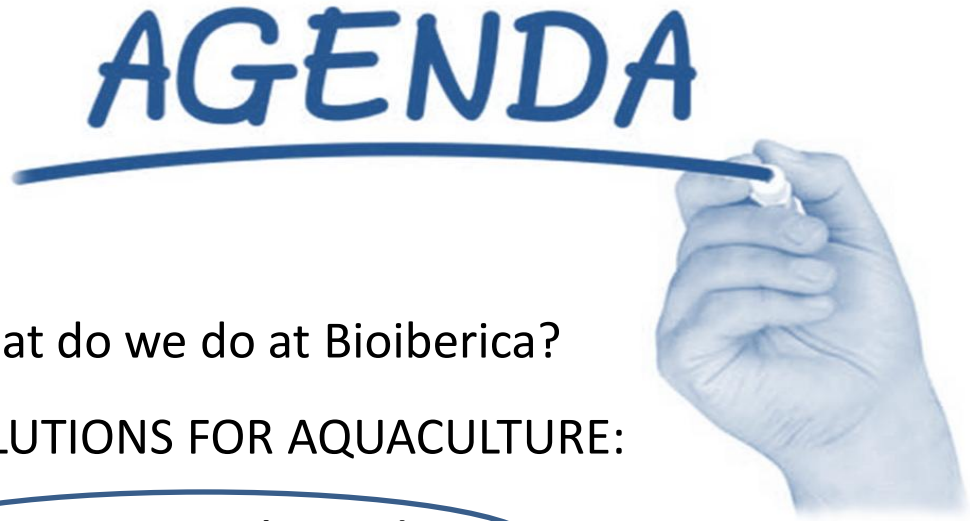
  Adverse **climate** conditions
  Globalization of pathologies
  Tendency to ↑**seeding densities**
  Prohibition of growth promoters
  Variations in cost of raw materials for diets

- Some of **major lines of <u>recent development in the AQUACULTURE</u> industry**:

  Improved **genetics**
  Increased **knowledge on biology and handling**
  Improved **facilities** and
  Advances in NUTRITION

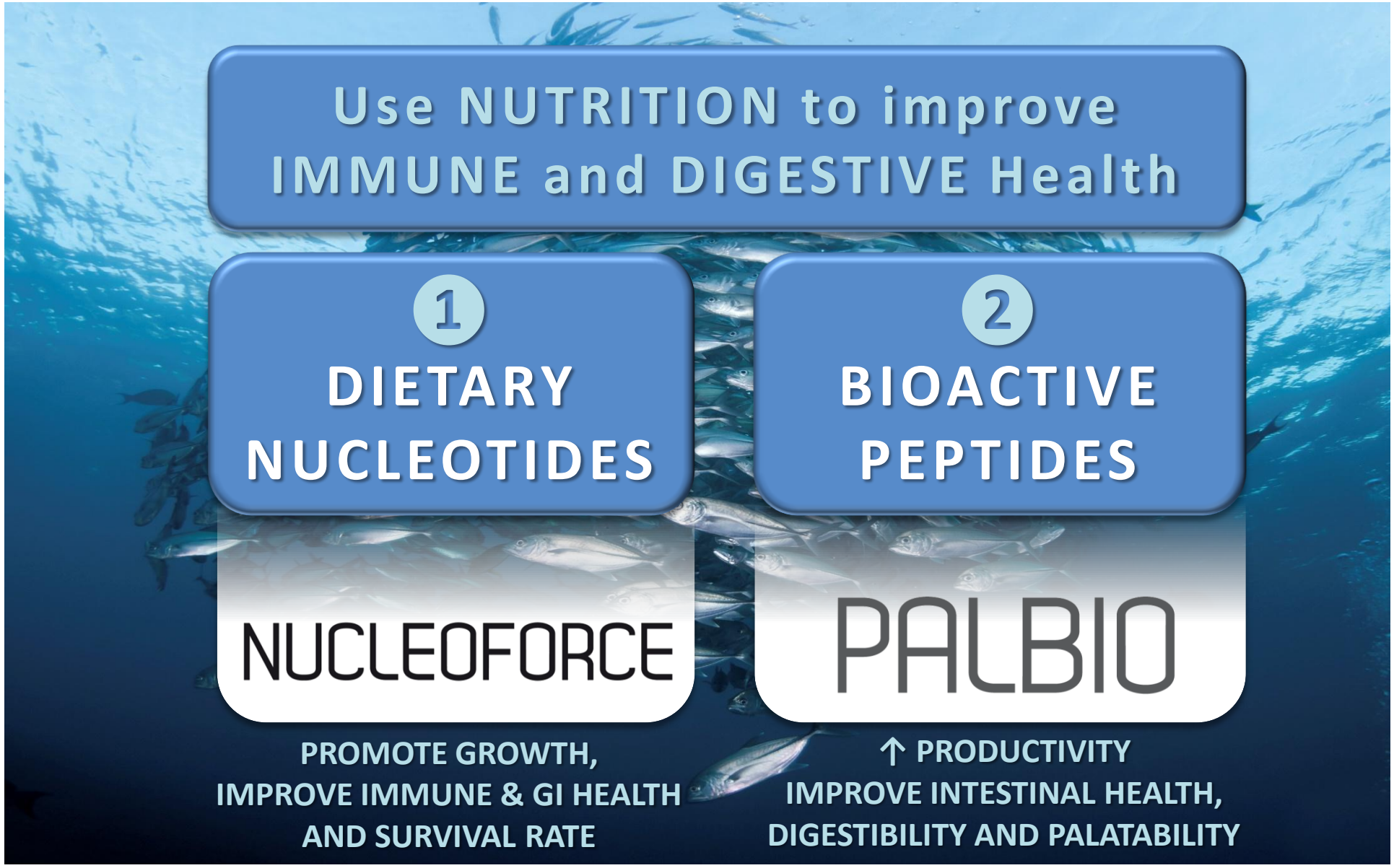
Design diets and **nutritional strategies** which have a positive effect on animal **HEALTH**

Using NUTRITION to improve Immune and Digestive Health

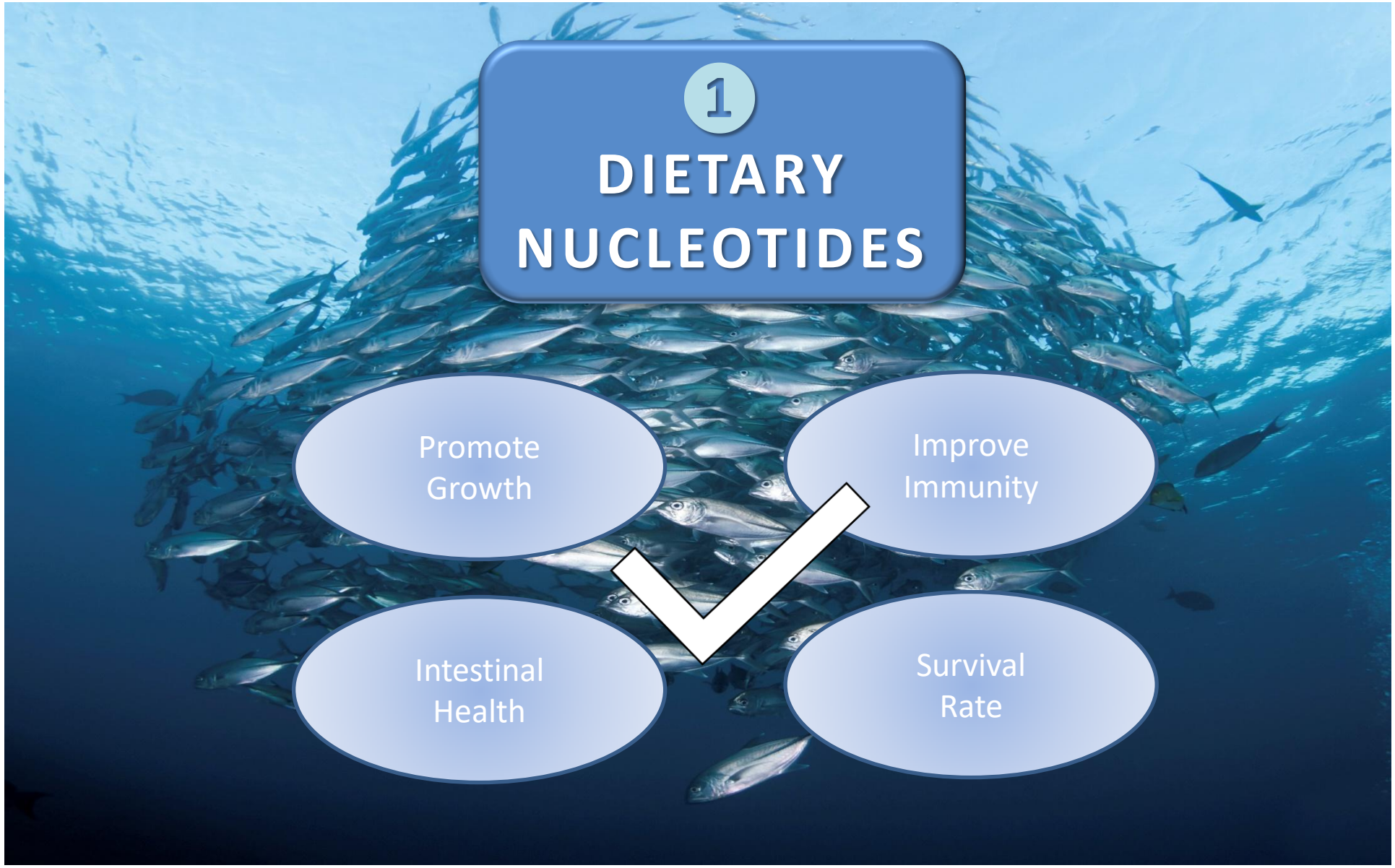


1. What do we do at Bioiberica?
2. SOLUTIONS FOR AQUACULTURE:
   - Dietary nucleotides
   - Hydrolysed protein (bioactive peptides)
3. Scientific Evidences
4. A look to the future

The CONCEPT:


Use NUTRITION to improve
IMMUNE and DIGESTIVE Health
1
DIETARY
NUCLEOTIDES
2
BIOACTIVE
PEPTIDES
NUCLEOFORCE
PALBIO
PROMOTE GROWTH,
IMPROVE IMMUNE & GI HEALTH
AND SURVIVAL RATE
↑ PRODUCTIVITY
IMPROVE INTESTINAL HEALTH,
DIGESTIBILITY AND PALATABILITY

The CONCEPT: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DIETARY NUCLEOTIDES
Promote Growth
Improve Immunity
Intestinal Health
Survival Rate

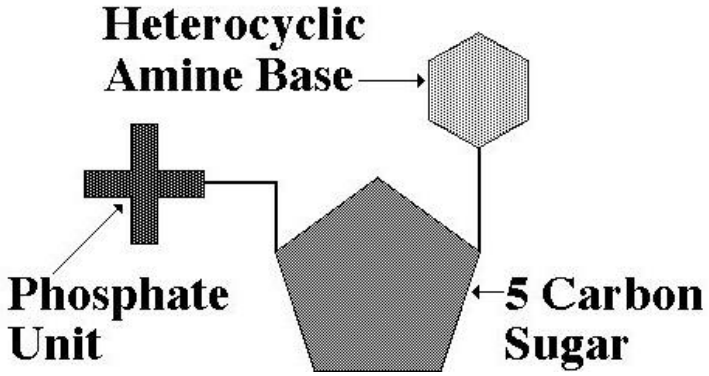
Dietary NUCLEOTIDES

Structure:

- *NUCLEOBASE (nitrogenous base)*
- *FIVE-CARBON SUGAR (ribose/desoxyribose)*
- *1 or more PHOSPHATE GROUPS*

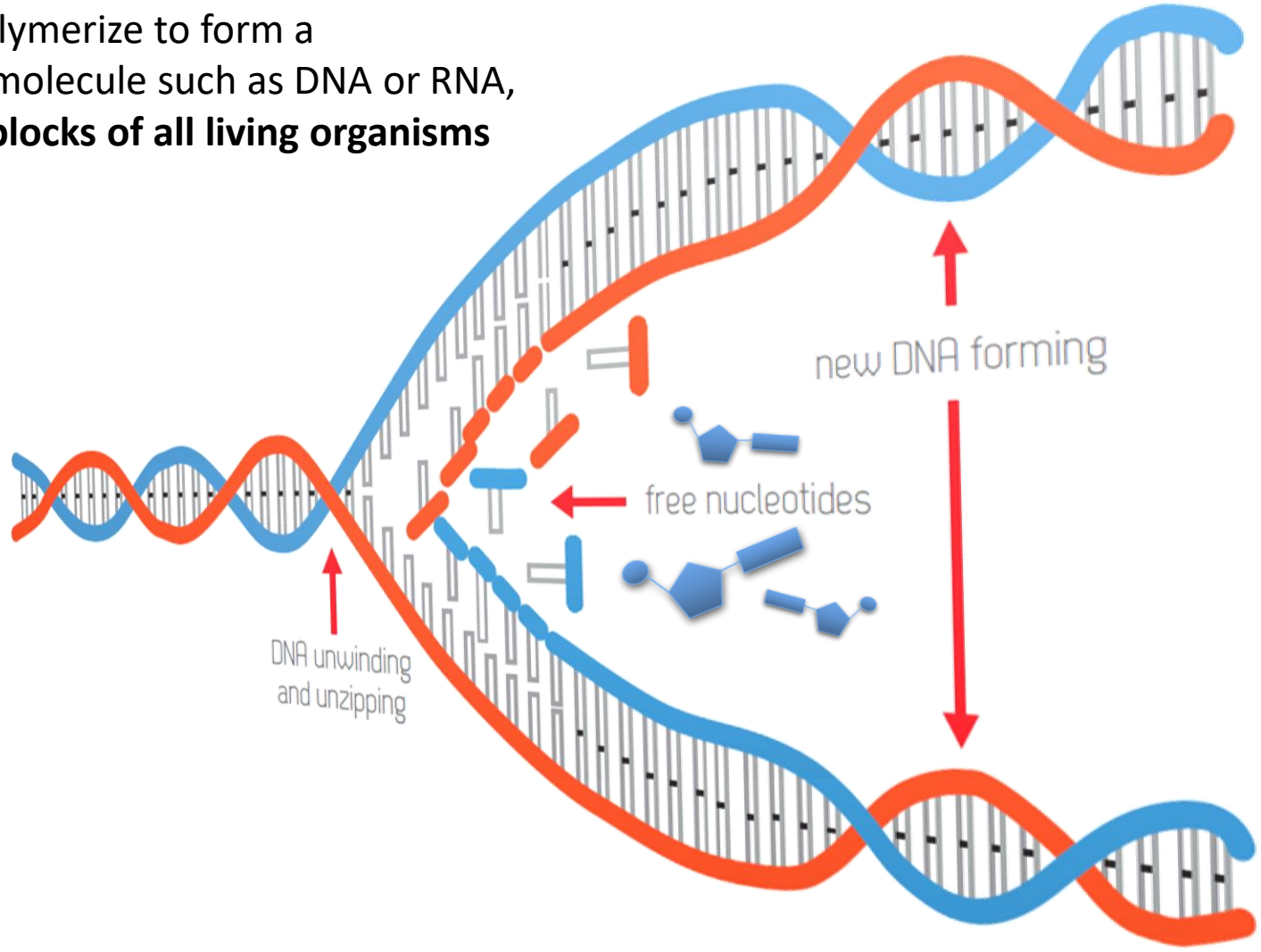
Purine Nucleotides (ATP, GTP, IMP)
Pyrimidine Nucleotides (UTP, CTP, TMP)

Commonly are confused with Protein because both molecules has Nitrogen



Dietary NUCLEOTIDES

Nucleotides can polymerize to form a nucleic acid macromolecule such as DNA or RNA, **the basic building blocks of all living organisms**



Dietary NUCLEOTIDES

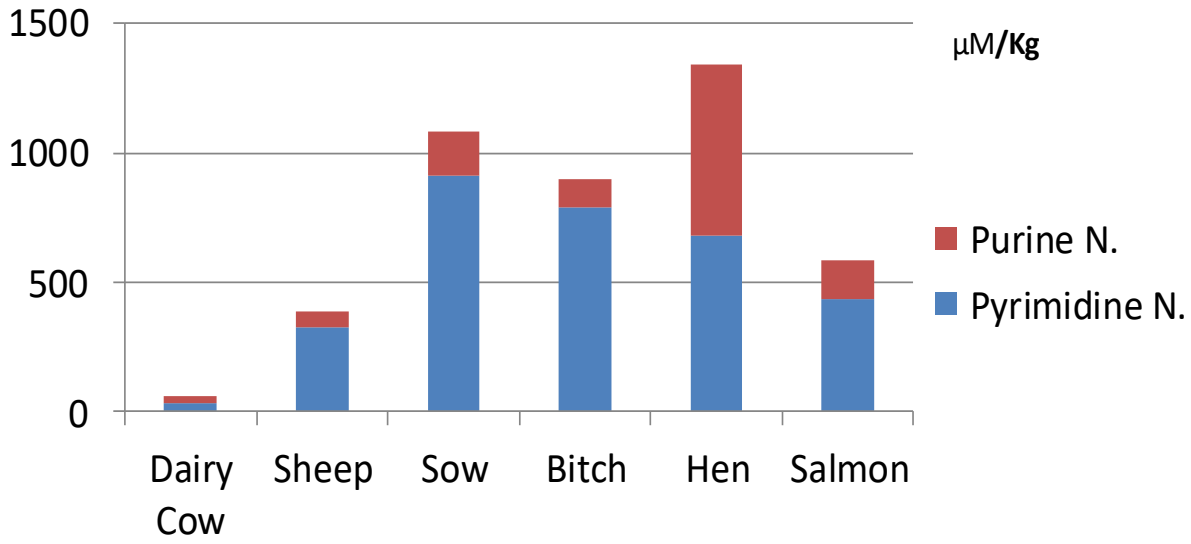
NUCLEOTIDES in **pediatric nutrition**:

1980s: Epidemiological studies:
Breastfed babies less diarrhea episodes than those fed with processed milk
The difference between *breast milk* (human) and *formulated milk* (cow): **NUCLEOTIDES**
→Addition of nucleotides to infant formulations

1991:
EU Scientific Committee on Food:
Nucleotides included in the recommendations of **infant formulas**

Dietary NUCLEOTIDES

Bioiberica decided to extrapolate to other species
...but NUCLEOTIDE PROFILES ARE **SPECIES-SPECIFIC!**



OUR APPROACH: Tailor-made products

SPECIFIC PRODUCT FOR SPECIE

SPECIFIC PRODUCT FOR SPECIE

SPECIFIC PRODUCT FOR SPECIE

NUCLEOFORCE PIGLETS
Immunity & Intestinal Health

NUCLEOFORCE POULTRY
Immunity & Intestinal Health

NUCLEOFORCE COWS
Immunity & Fertility

NUCLEOFORCE DOGS
Immunity & Intestinal Health

NUCLEOFORCE SHRIMPS
Immunity & Growth

NUCLEOFORCE SALMONIDS
Immunity & Intestinal Health

NUCLEOFORCE FISH
Immunity & Intestinal Health

NUCLEOFORCE HORSES
Immunity & Intestinal Health

Nucleotides considered semiessential nutrients

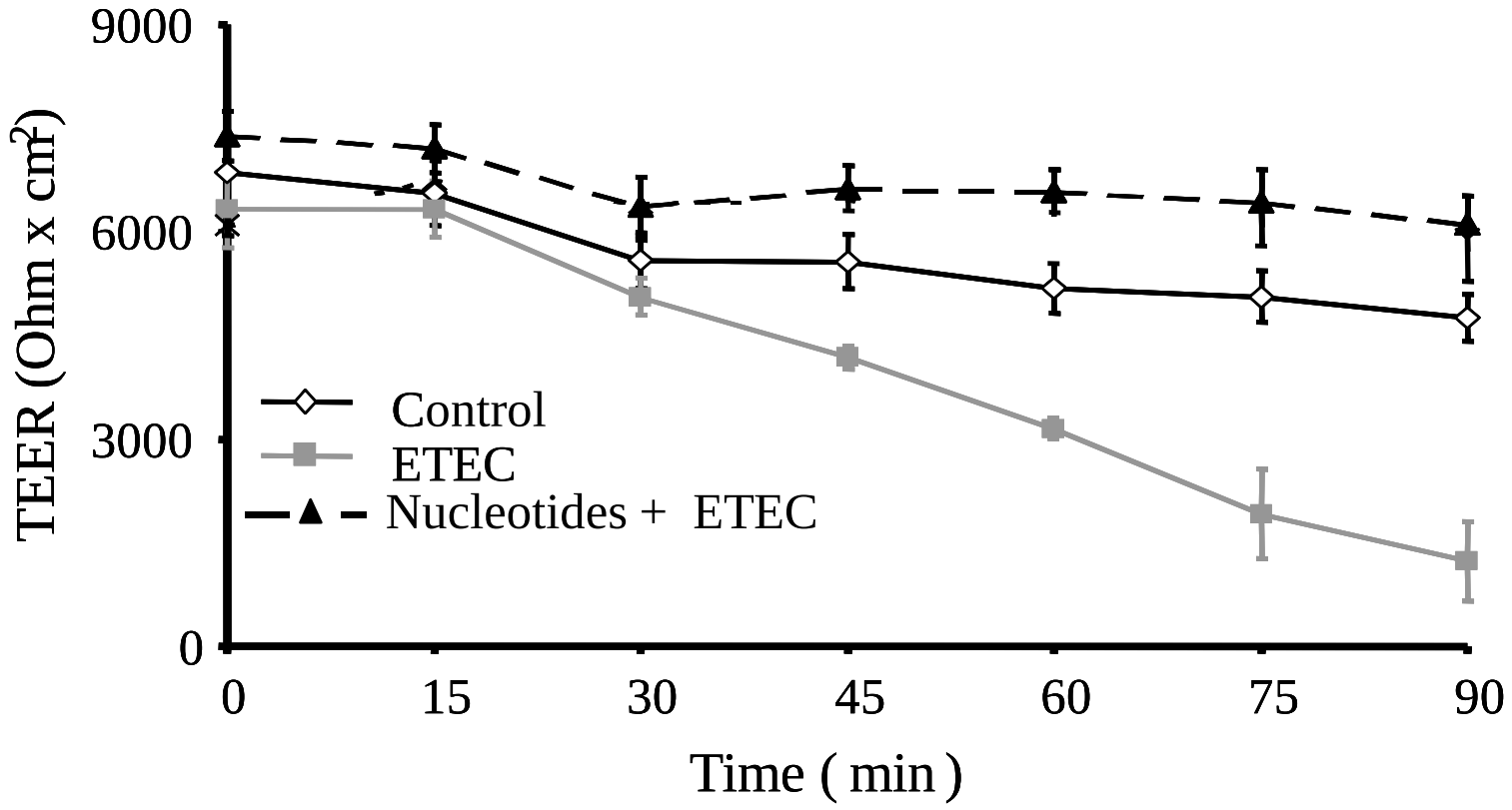
Aquatic species show a **faster growth** compared to terrestrial species

Aquatic species have been recently domesticated, so they are **more sensitive to stress**

Use of vegetable proteins causes **intestinal damage** that should be repaired quickly to avoid production losses

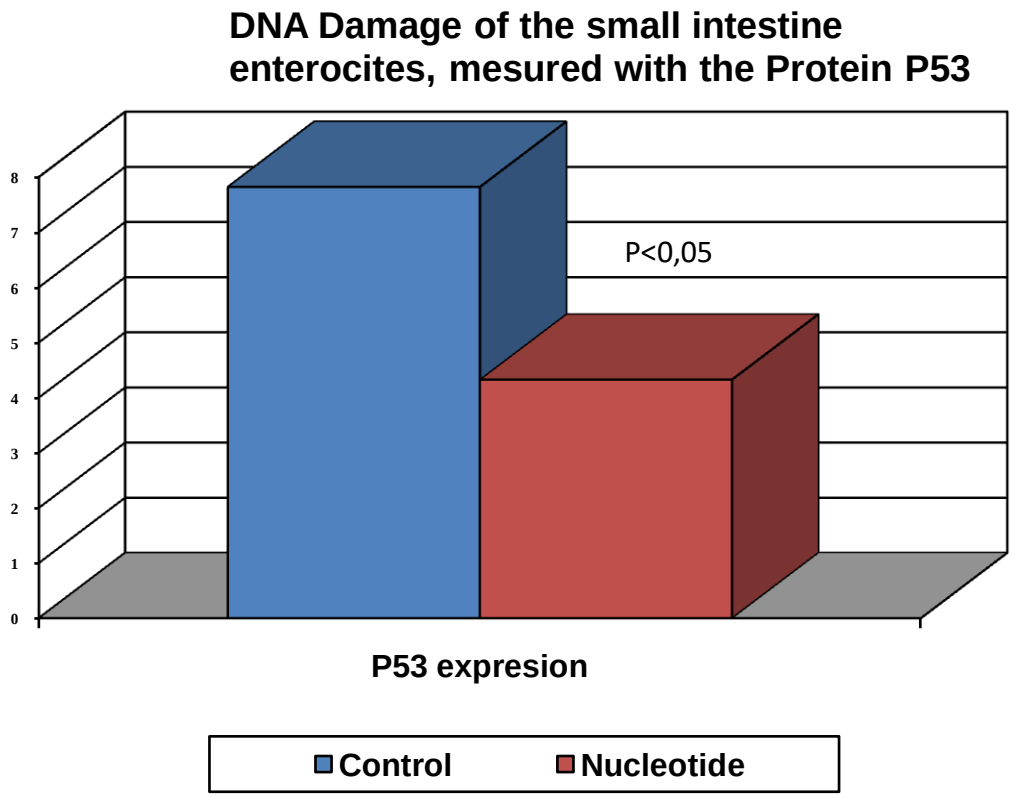
Scientific data: **Nucleoforce in the LAB**

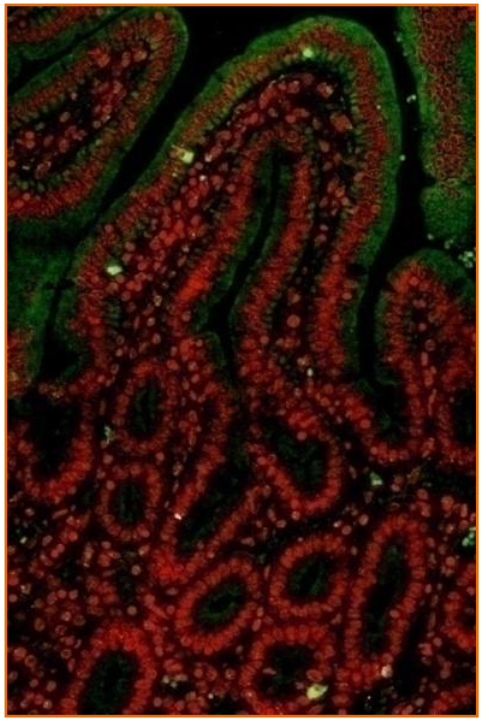
Protective effect of nucleotides against membrane permeability increase caused by enterogenic E.Coli ETEC K88 on IPEC-1 cells. JOURNAL OF TOXICOLOGY, ROSELLI ET AL. 2007



Scientific data: **Nucleoforce in the LAB**

Nucleotides reduce the expression of the protein P53. LIVESTOCK SCIENCE, GODLEWSKY ET AL, 2009





Scientific data: **Nucleoforce SHRIMPS**

Effects of dietary nucleotides (Nucleoforce Shrimps™) on survival of *Litopenaeus vannamei*

CENAIM RESEARCH CENTER, ESPOL, ECUADOR, 2014

Objective: evaluate effects of 2 diets on growth performance and health status of *L. vannamei*

Treatments: 1,000 animals initially PL27

- Treatment 1: supplementation 500 ppm **NF SHRIMPS™**
- Treatment 2: no supplementation (Control)
  (5 replicates per treatment)

Methods:

Growth Stage: 0.02 g - 4 weeks of life
5 tanks of 500 L with 500 Shrimps
per treatment

Parameters:
growth, survival rate, biomass

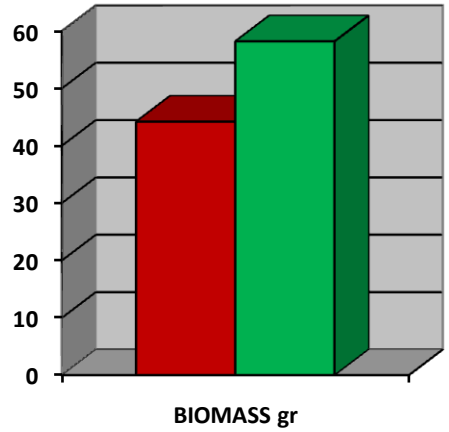
Scientific data: **Nucleoforce SHRIMPS**

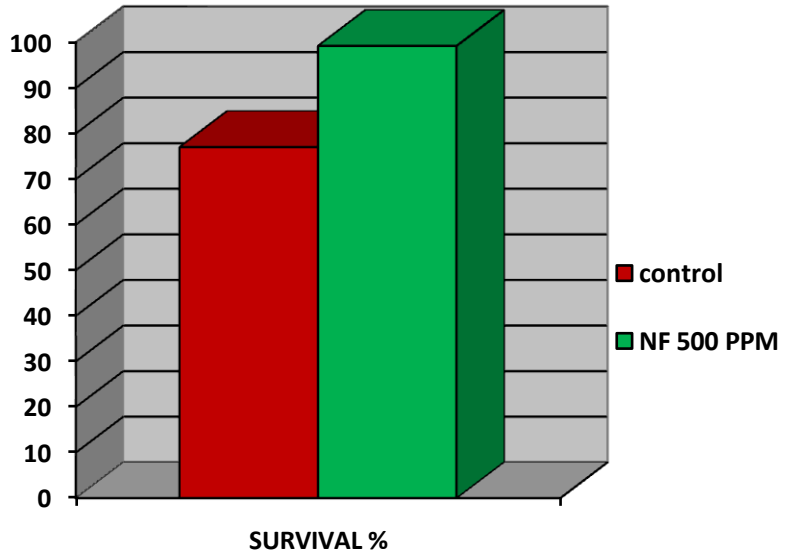
Effects of dietary nucleotides (Nucleoforce Shrimps™) on survival of *Litopenaeus vannamei*

CENAIM RESEARCH CENTER, ESPOL, ECUADOR, 2014

Results after 4 weeks:

		Biomass (gr)	Survival (%)
Control		44.6 b	76.96 b
NF SHRIMPS		58.52 a	99.2 a





Conclusion:

Inclusion of 500 ppm of *Nucleforce Shrimps™* had a positive effect on **survival rate** of *L. vannamei*

Scientific data: **Nucleoforce SHRIMPS**

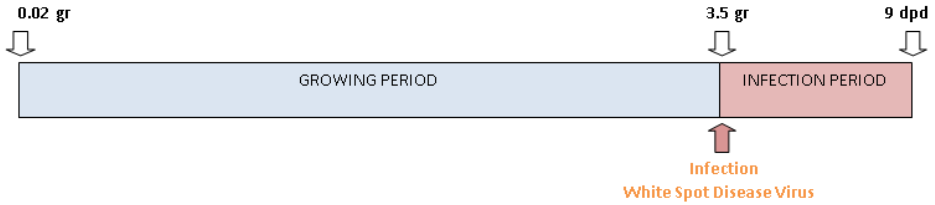
Effects of dietary nucleotides (Nucleoforce Shrimps™) on survival of *Litopenaeus vannamei* infected with White spot syndrome virus (WSSV)

CENAIM RESEARCH CENTER, ESPOL, ECUADOR, 2014

Objective: Determine the effect of Nucleoforce Shrimps™ inclusion on the diet of shrimps (*Litopenaeus vannamei*) on its performance and survival rate when exposed to **White Spot Disease**

Treatments:

- Group 1: supplementation 500 ppm **NF SHRIMPS™**
- Group 2: no supplementation (Control)



Methods:

- **Growing Period**: 1000 animals of 0.02 g until 3.5 gr
  500 animals per treatment, 5 replicates
  per treatment of 100 animals in 500L tanks
- **Infection Period**: Selection of **200 animals,**
  100 animals per treatment, 10 replicates of 10 animals per treatment in 40L tanks.

Data Collection:
Mortality at 9 days after the infection

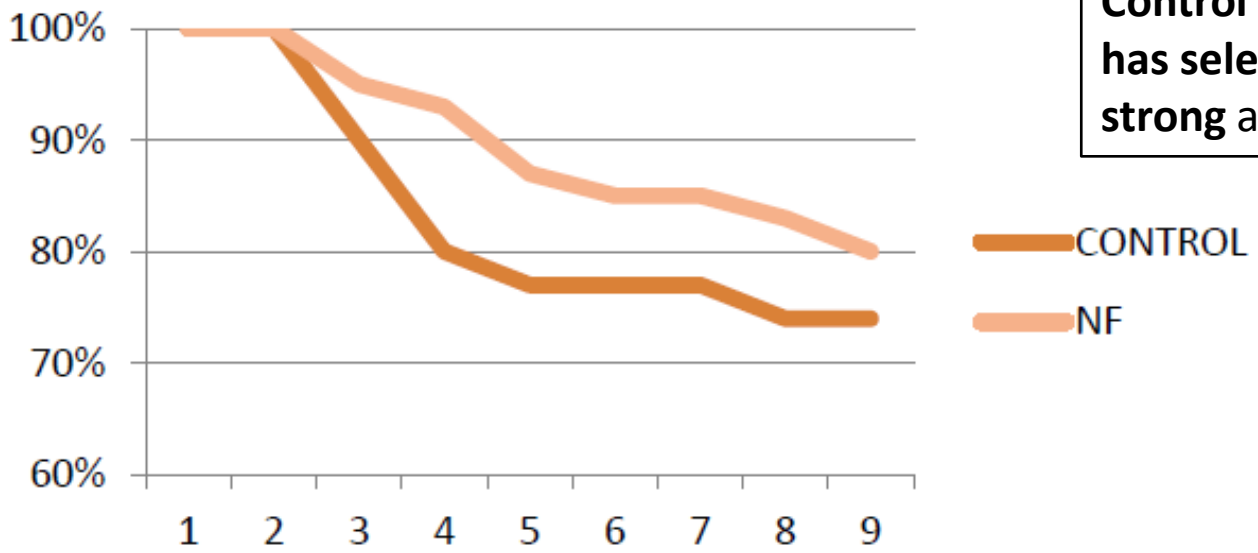
Scientific data: **Nucleoforce SHRIMPS**

Effects of dietary nucleotides (Nucleoforce Shrimps™) on survival of *Litopenaeus vannamei* infected with White spot syndrome virus (WSSV)

CENAIM RESEARCH CENTER, ESPOL, ECUADOR, 2014

Results:

Survival after challenge / days after infection



Is necessary remember that **Control Group has selected strong** animals !

Conclusion:

500 ppm of Nucleoforce™ in the feed had a positive effect on the survival rate of *L. Vannamei* during the growing period and reduced the mortality when shrimps were infected with WSSV

Scientific data: **Nucleoforce SHRIMPS**

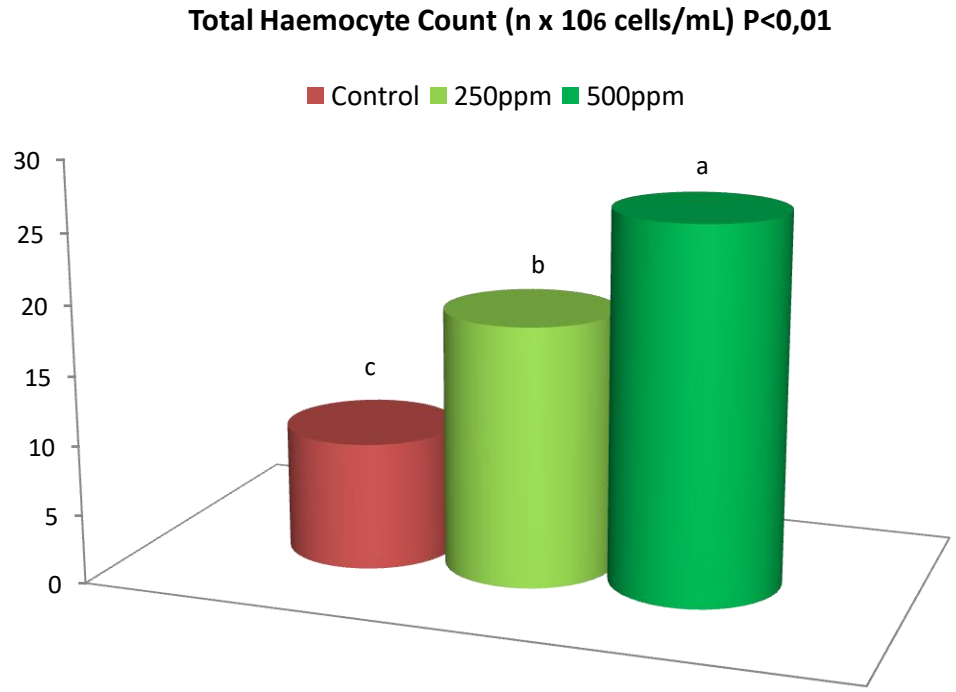
Immunity and growth performance of giant tiger prawn (*Penaeus Monodon*) after administration of dietary nucleotides

Visayas State University. THE PHILIPPINES, 2009

Objectives: Determine effects of NF Shrimps™ administration to giant tiger prawn in pond conditions

Parameters:

- Immune system: haemocyte count
- Growth
- Survival rate



Results:

- Significantly **increased haemocyte count after 10 weeks**
- Nucleoforce® inclusion significantly enhanced the proportion of granulocytes, semigranulocytes and hyalinocytes in the shrimp haemolymph

Scientific data: **Nucleoforce SHRIMPS**

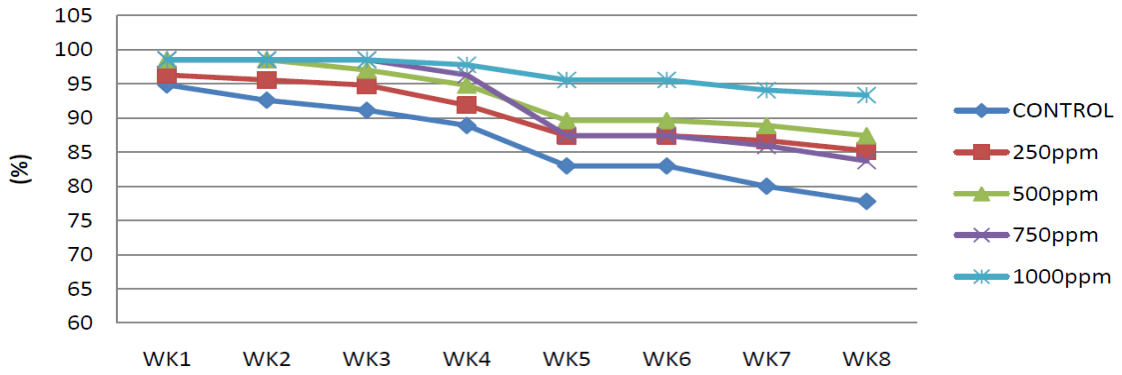
Immunity and growth performance of giant tiger prawn (*Penaeus Monodon*) after administration of dietary nucleotides

Visayas State University. THE PHILIPPINES, 2009

Results:

Increased survival rate: 500 ppm and 1000 ppm of ***Nucleoforce™*** **significantly improved survival rate** during the early stage of the prawns

DOSAGE	AVERAGE SURVIVAL RATE (%)							
	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8
Control	94.82	92.59b	91.11b	88.89	82.96	82.96	80.00	77.78
250 ppm	96.29	95.56ab	94.81ab	91.85	87.41	87.41	86.67	85.19
500 ppm	98.52	98.52a	97.03a	94.81	89.63	89.63	88.89	87.41
750 ppm	98.52	98.52a	98.52a	96.29	87.41	87.41	85.93	83.70
1000 ppm	98.52	98.52a	98.52a	97.78	95.56	95.56	94.07	93.33



Scientific data: **Nucleoforce SHRIMPS**

Immunity and growth performance of giant tiger prawn (*Penaeus Monodon*) after administration of dietary nucleotide supplementation

Visayas State University. THE PHILIPPINES, 2009

Results:

Increased growth

Growth increments based on total length (mm)

Weeks	Nucleoforce™		
	Control	250ppm	500ppm
1	20,7	22,6	23,2
2	33,5	33,2	36,9
3	46,3	49,2	50,2
4	55,6	63,6	64,2
5	66,3	67,9	70,1
6	72,5	75,3	74,9
7	80,1	82,0	81,4
8	83,9	84,3	88,3
9	88,5	90,3	91,8
10	89,6	94,0	99,1

Growth increments based on body weight (gr)

Weeks	Nucleoforce™		
	Control	250ppm	500ppm
1	0,05	0,07	0,08
2	0,24	0,22	0,29
3	0,53	0,65	0,74
4	1,02	1,58	1,54
5	1,70	1,87	2,00
6	2,25	2,60	2,57
7	2,88	3,30	3,33
8	3,64	3,87	4,00
9	4,12	4,5	4,61
10	4,46	4,96	5,26

Conclusion:

Dietary supplementation with Nucleoforce® enhances growth performance, survival and immunity of *P. monodon*, enabling the shrimps to fight infection or disease

Scientific data: **Nucleoforce SALMONIDS**

Effects of NF Salmonids on atlantic salmon

Aquatic Health, Puerto varas, Chile, 2005

Objective:

The purpose of this study is to investigate the beneficial effects NF Salmonids on the immune response in salmons challenged with *Piscirickettsia salmonis*

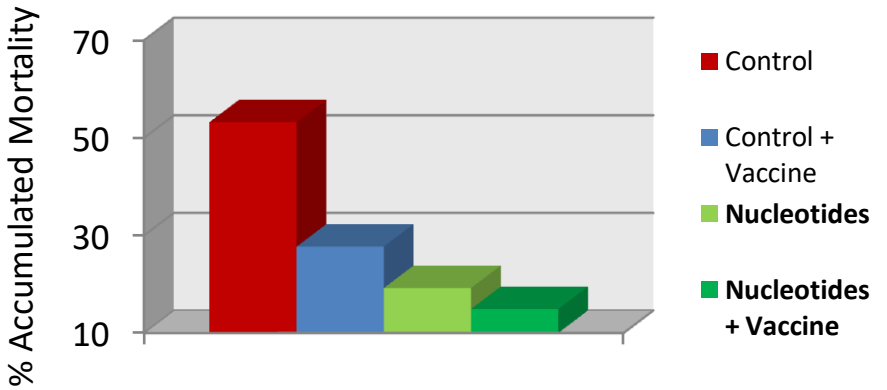
Material & Methods:

- **1100 Atlantic Salmon** (*Salmo salar*) randomly distributed in 10 tanks
- **Control** *vs* **vaccine** *vs* **NF** *vs* **NF + vaccine**

Results:

71-103 days post intraperitoneal challenge with LD50 of *Piscirickettsia Salmonis*,

- In **not vaccinated fish, NF supplementation reduced mortality** rate



Scientific data: **Nucleoforce SALMONIDS**

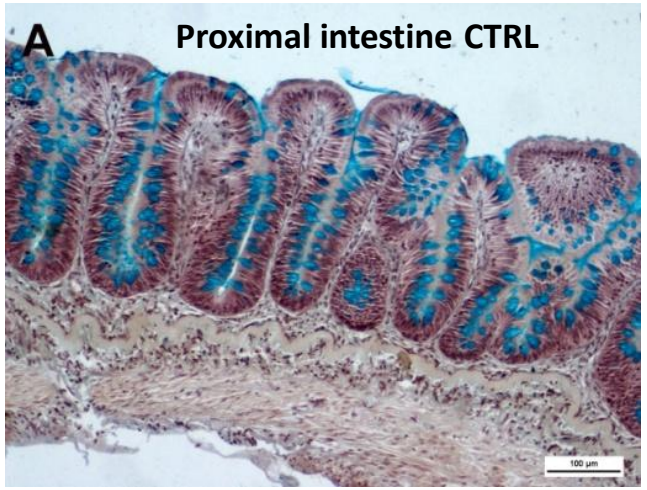
Effect of Nucleotides in Atlantic salmon diets with vegetable protein content *(Salmo salar)*

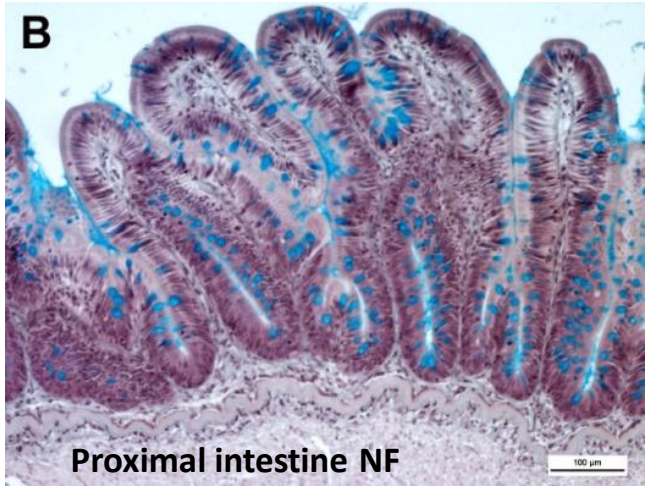
Veterinary School of the University of Warsaw, Poland 2010

Raw material	Control	Nucleoforce™
Soya bean concentrate (Imcosoy)	**26,15**	**26,15**
Fish meal Scandinavia	**22,85**	**22,85**
Wheat	22,90	22,85
Rapeseed oil	13,66	13,66
Fish oil	9,11	9,11
Wheat gluten	3,02	3,02
Mineral mix[1]	2,31	2,31
Nucleotides		0,05

Table1 - Isoproteic and Isoenergetic diet

	Fold height (µm)	Goblet cell number per fold	Goblet cell number per 100µm of fold	Total enterocyte area (µm²)	Enterocyte supranuclear area (µm²)	Enterocyte supranuclear/ total area (%)
CTRL	474 ± 98	**29** ± 6	**5.95** ± 1.28	269 ± 26	121 ± 16	45 ± 4
NF	**520** ± 45	24 ± 2	4.59 ± 0.40	**296** ± 33	**139** ± 20	**48** ± 11
p	0.133	**0.014***	**0.002**	**0.039**	**0.019**	0.931





Conclusions:

- **CTRL group significantly lower folds in proximal intestine**, and tendency to shorter folds in distal
- **CTRL group higher number of goblet cells** in the proximal and distal intestine

Scientific data: **Nucleoforce FISH**

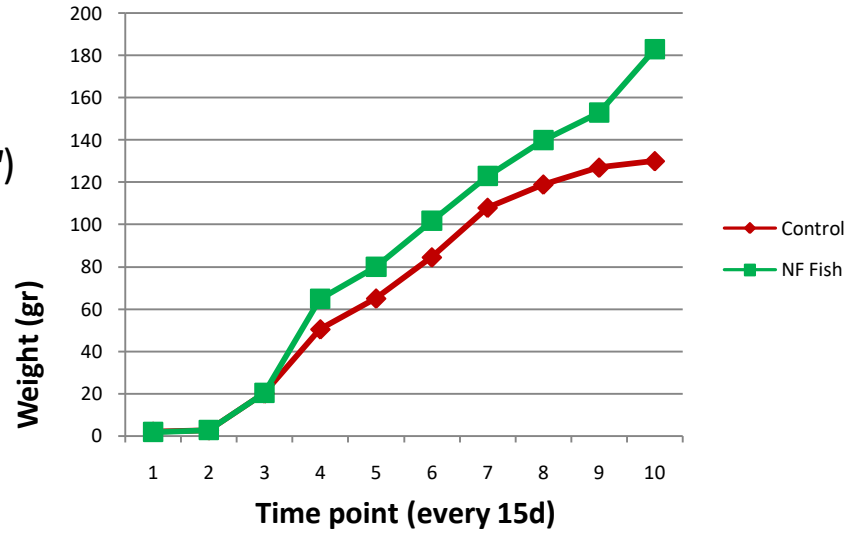
Effects of diets supplemented with nucleotides on the performance and health of Tilapia

GIFT Foundation in Central Luzon State University (CLSU) in Nueva Ecija. Phillippines 2010

Objective: Evaluate the overall effect of nucleotides on the performance and health of tilapia

Treatments:

1. Basal diet (Control)
2. Basal diet +0.05% nucleotides (***Nucleoforce Fish™***)



Fish fed with basal diet and the added nucleotides ***Nucleoforce Fish™*** showed a better growth performance, nutrient utilization and survivability compared with the fish fed with basal diet alone.

Conclusion:

- Nucleotide is essential to the **growth** and health of tilapia
- Tilapia fed with NF exhibited faster growth and more efficient conversion of feed to body mass

Scientific data: **Nucleoforce FISH**

Evaluation of the effects of the supplement Nucleoforce Fish on the productive output of juvenile meagre receiving diets with a high vegetable protein content (75%).

Aquaculture Research Center INRB, IP/ IPIMAR in Olhao, Portugal 2012

Aim: to evaluate the effect, in terms of productive output, of a free nucleotide concentrate (Nucleoforce Fish) when **added as a supplement to a diet with high vegetable protein content**

Animals, materials and methods:
360 Juvenile meagre 37.2 g (± 0.8 g)
Housed in 12 tanks (30 fish per tank) at the IPIMAR facilities.

- **CONTROL diet**, containing **75% vegetable proteins**.
- **NUCLEOFORCE diet** same diet + 1,000 ppm NF FISH

Both diets were isoproteic and isoenergetic
Experiment performed over a **60d period**

Experimental diets for meagre (75 % of the protein was of vegetable origin)

Ingredients (%)	Control	Nucleotide
Fishmeal 65	17,50	17,50
Soycomil PC	10,00	10,00
Corn gluten	16,50	16,50
Soybean meal 48	16,00	16,00
Rapeseed meal	9,00	9,00
Sunflower meal	3,90	3,90
Whole wheat	7,00	7,00
Fish oil	7,50	7,50
Soybean oil	6,30	6,30
NUCLEOFORCE	0,00	0,10

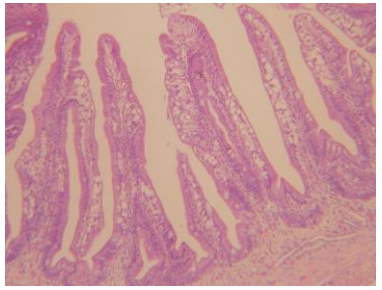
Scientific data: **Nucleoforce FISH**

Evaluation of the effects of the supplement Nucleoforce Fish on the productive output of juvenile meagre receiving diets with a high vegetable protein content (75%).

Aquaculture Research Center INRB, IP/ IPIMAR in Olhao, Portugal 2012

Results:

- **Higher weight** fed with NF
- NF Significant **increase in leucine aminopeptidase activity** **(increased enterocytes functionality)**
- Improved **intestinal morphology**



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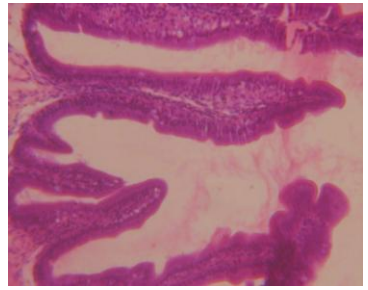
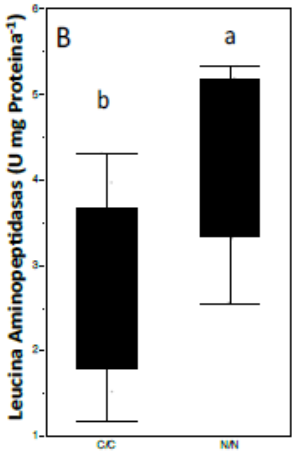
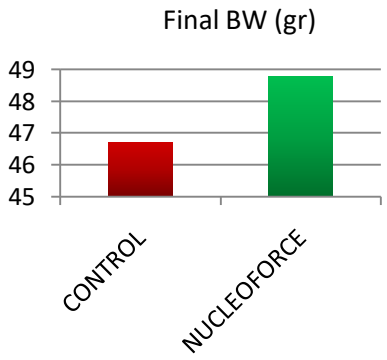


NF



	CONTROL	NUCLEOFORCE
Initial BW (g)	39.9 ± 1.1	41.1 ± 1.0
Final BW (g)	**46.7 ± 2.5 b**	**48.8 ± 1.3 a**
Survival rate (%)	97.8	100
Leucine aminopeptidase intestinal activity (U/mg protein)	**2.7 b**	**4.0 a**



Conclusion: Supplementing the high vegetable protein diets of meagre with Nucleoforce Fish yields significant improvements in the animals weight and productive output

Scientific data: **Nucleoforce FISH**

Evaluation of the effects of the supplement Nucleoforce Fish on the productive output of juvenile gilthead sea bream receiving 100% plant-based fishmeal-free diets

Aquaculture and Biodiversity Group at the Universitat Politècnica de Valencia. Spain, 2014

Aim: Evaluate the effects of a free nucleotide concentrate (Nucleoforce Fish) used to supplement the diet of gilt-head sea bream formulated exclusively with plant proteins in the **complete absence of fishmeal**

Animals, material and methods:

- Feeds manufactured via an extrusion process
- Manually fed to apparent satiety, twice per day, six days per week
- **Administration over 134 days**
- Fish housed in fifteen 1 m^3 baskets contained in 4000-litre tanks
- Temperature: 22-24°C throughout the trial

- **Evaluations**: Growth (final weight and growth rate) and nutritional efficiency (food conversion ratio)

Ingredient	CONTROL	NF250	NF500
	g/kg	g/kg	g/kg
Fishmeal	-	-	-
Wheat meal	-	-	-
Wheat gluten	290	290	290
Lima Bean meal	44	44	44
Soybean meal	182	182	182
Peas	44	44	44
Sunflower	181	181	181
Nucleoforce Fish		**0.25**	**0.50**

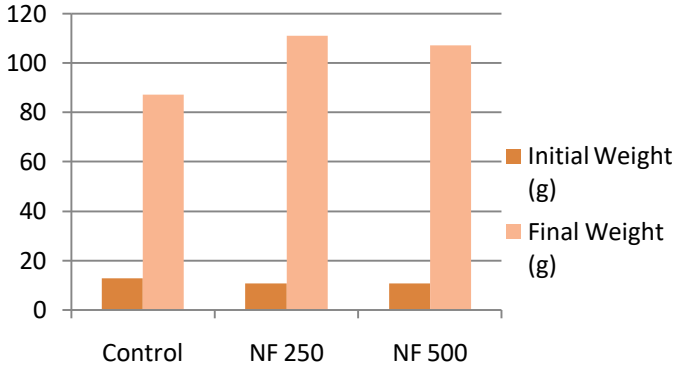
Scientific data: **Nucleoforce FISH**

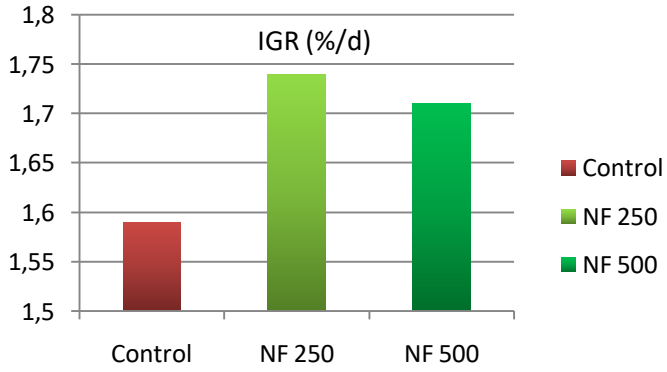
Evaluation of the effects of the supplement Nucleoforce Fish on the productive output of juvenile gilthead sea bream receiving 100% plant-based fishmeal-free diets

Aquaculture and Biodiversity Group at the Universitat Politècnica de Valencia. Spain, 2014

Results:

TREATMENT	CONTROL	NF 250	NF 500
Initial weight (g)	12.7a	10.6a	10.6a
Final weight (g)	**87b**	**111a**	**107a**
IGR (%/day-1)	**1.59b**	**1.74a**	**1.71a**





Conclusion:

Improved effects on **productive performance and intestinal health** when diets supplemented with NF FISH

Summary **AQUACULTURE – R&D Bioiberica Animal Health:**

Need for new tools and mechanisms to enhance growth of the aquaculture industry

Design diets and NUTRITIONAL STRATEGIES with positive effects on animal health while avoiding negative impact of current challenges

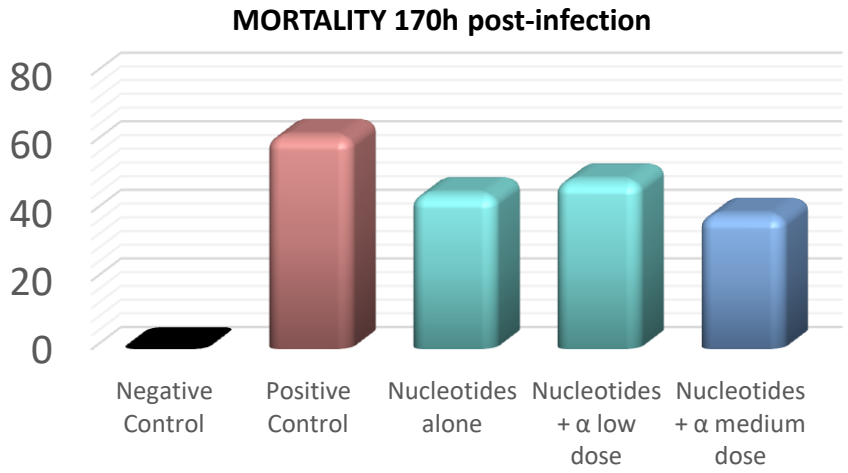
- **Nucleotides** NUCLEOFORCE **for aquaculture**:
  - Promote **growth** and improve **immune & intestinal health**
  - Good **scientific evidence** in humans and other species
  - Building up more **scientific support for fish and shrimps**

2018: ONE STEP BEYOND… ADDING ALPHA-LUCANS to improve formulation?

NEW Scientific data is comming soon …

1 **Effects of DIETARY NUCLEOTIDES plus α-GLUCANS on in white shrimp *Litopenaeus vannamei* affected by Acute Hepatopancreatic Necrosis Disease (AHPND)**

2 **Development of NUCLEOTIDE Formula for Sea Cucumber**



A look to the future

… AQUACULTURE is the future

"We must plant the sea and herd its animals…

using the sea as farmers instead of hunters.

That is what civilization is all about –

farming replacing hunting"

Jacques-Yves Cousteau 1971

Thank you for your attention

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