

AN INTEGRATED LARVAL SHRIMP REARING APPROACH WITH

FOCUS ON NUTRITION AND PL QUALITY:

Stretching the balance between
experimental feed and *Artemia*

UNA PROXIMACIÓN INTEGRAL AL CULTIVO LARVARIO CON ENFOQUE EN LA
NUTRICIÓN Y LA CALIDAD DE LAS POST-LARVAS:

En búsqueda de un nuevo balance entre dietas experimentales y Artemia

Roeland Wouters

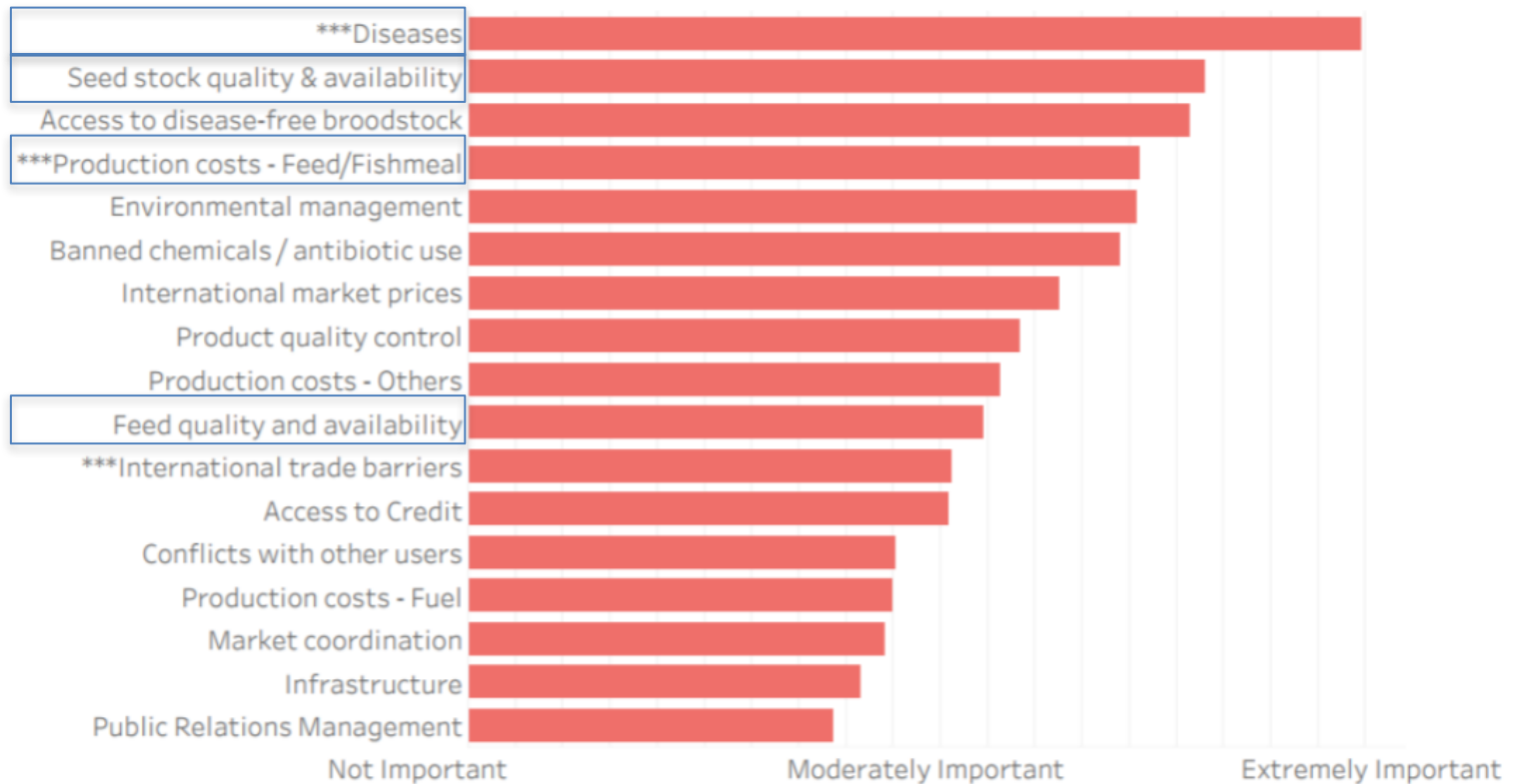
D. Grymonpre, C. De Maesschalck,
P. Joos, V. Calabuig, P. Rattayaporn, A. Rekecki,
E. Naessens, G. Rombaut, P. Lavens

Wednesday 25 October - 12:20 – 13:00



Introduction

GOAL 2017 Survey: Issues & Challenges in Shrimp Aquaculture - Asia

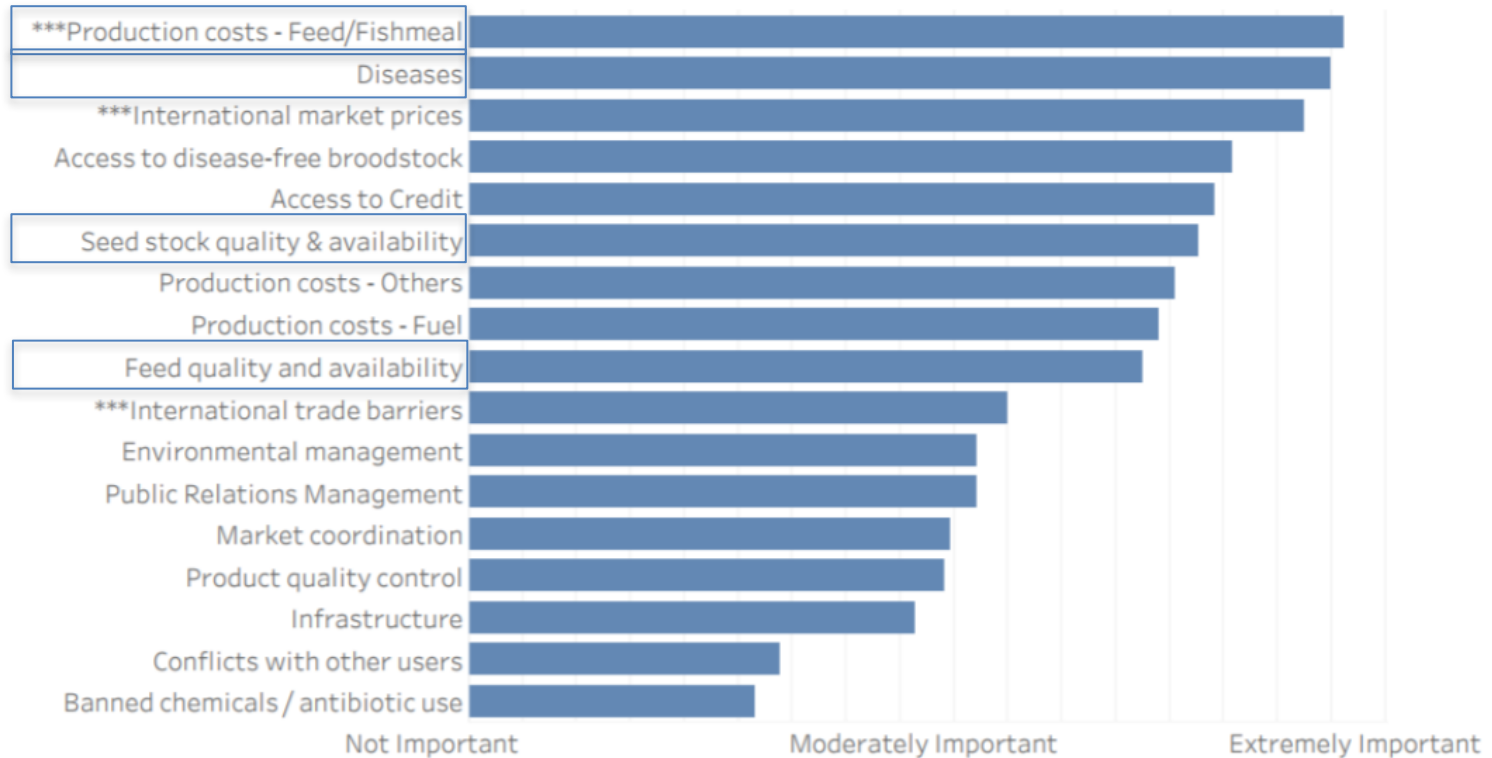


1. Disease > 2. PL quality & availability > 4. Feed cost > 10. Feed quality



Introduction

GOAL 2017 Survey: Issues & Challenges in Shrimp Aquaculture - Latin America



1. Feed cost > 2. Disease > 6. PL quality & availability > 9. Feed quality

Ecuador hatcheries

ucn

HOME ▶

PRICES ▶

SPECIES ▶

COMPANIES ▶

DOWNSTREAM ▶

UPSTREAM

Larvae availability a challenge

Several *Undercurrent* industry sources in Ecuador pointed to the availability of larvae as a challenge for the industry, which could potentially slow growth. According to some, this [has been an issue already since last year](#), but, despite this, Ecuadorian production has continued to grow in 2017 compared with last year.

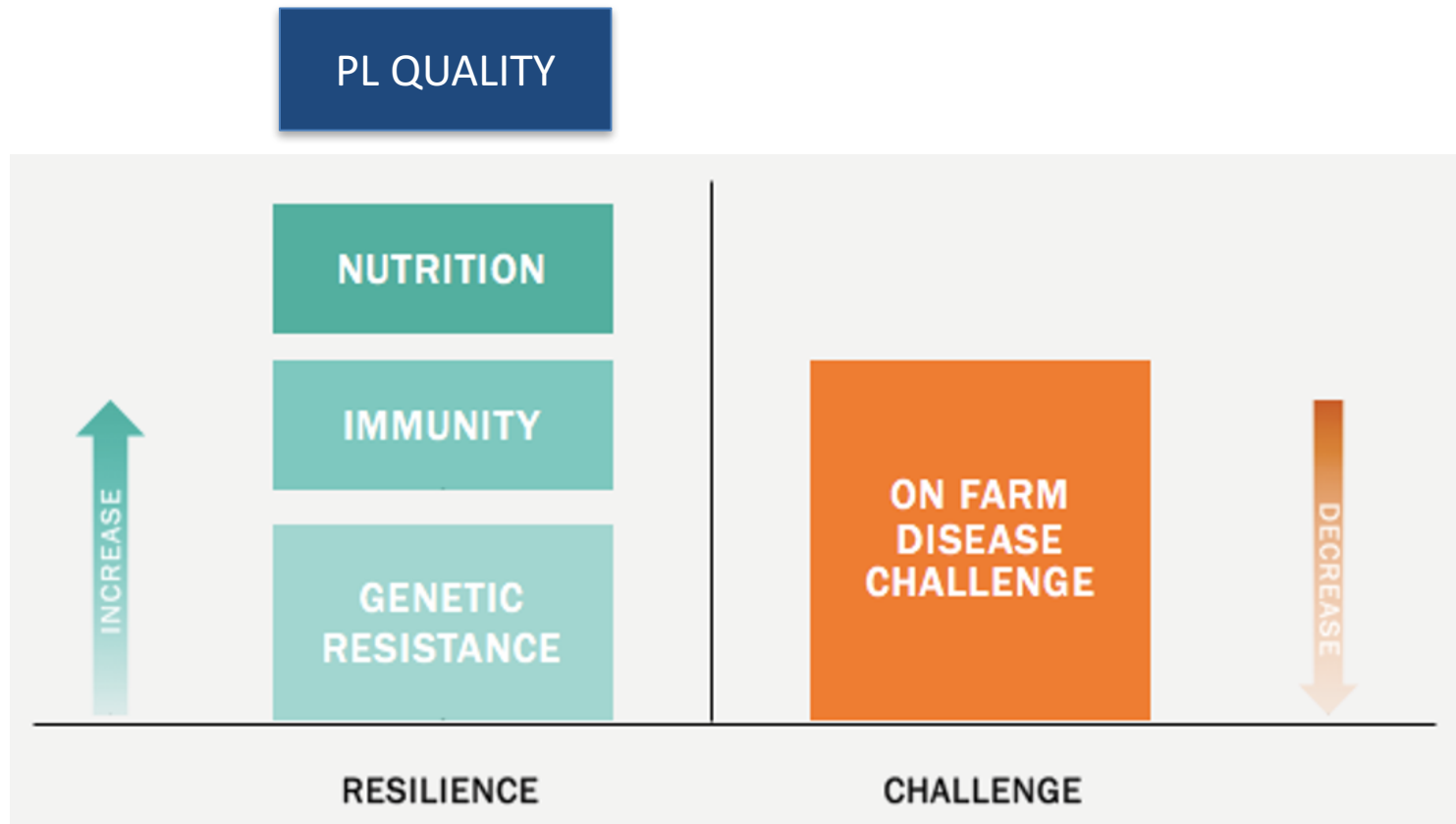
However, some sources said that the problem is becoming more serious.

"Massive death of larvae is occurring on all sides not only on the peninsula. Be careful in selecting larvae. This topic would have to be handled in a serious way. It is affecting all and future shrimp production could be reduced by the lack of quality larvae," one said.

The issue has caused closures of laboratories in the Santa Elena peninsula, according to a [blog post](#)."

Introduction

Holistic approach

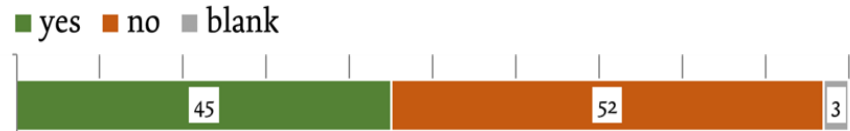


Introduction

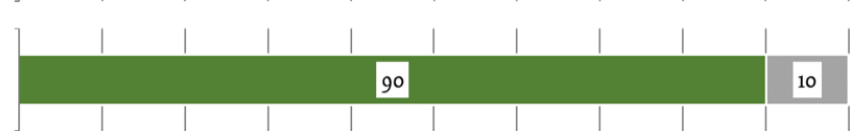
- Survey on PL Quality

E. Werbrouck *et al.* 2017

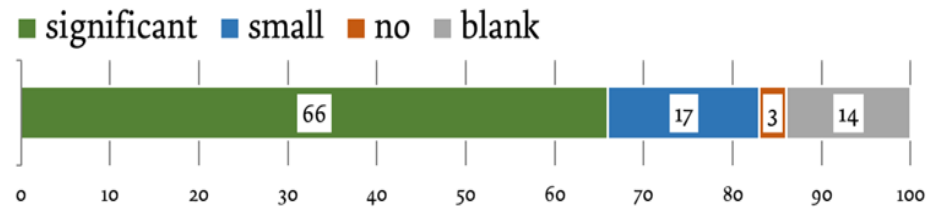
Is poor PL quality causing problems at present in your area?



Has hatchery nutrition a prolonged beneficial effect after stocking in grow-out ponds?



Is there a cost-benefit for the grow-out farmer if post-larvae of better quality are stocked?



Introduction

- **Robust PL's: Why?**
 - Postlarval quality and its long-term effects have grown in interest to hatchery and grow-out farmers as the shrimp industry faces **challenges overcoming diseases**, while moving towards greater **integration, genetic improvement** and increased control.
- **Robust PL's: How**
 - Improved larval rearing techniques
 - **Nutrition**
 - Innovative feeds that promote survival, growth and long-term PL quality
 - Decreased dependence on *Artemia* cysts
 - **Health**
 - Boost stress resistance and resilience
 - Microbial management / Reduce *Vibrio* load

Shrimp hatchery facilities at ITARC

Set1: 60x 175L tanks



Set2: 60x 175L tanks



24x 3MT tanks



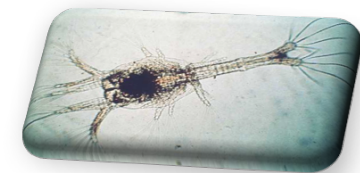
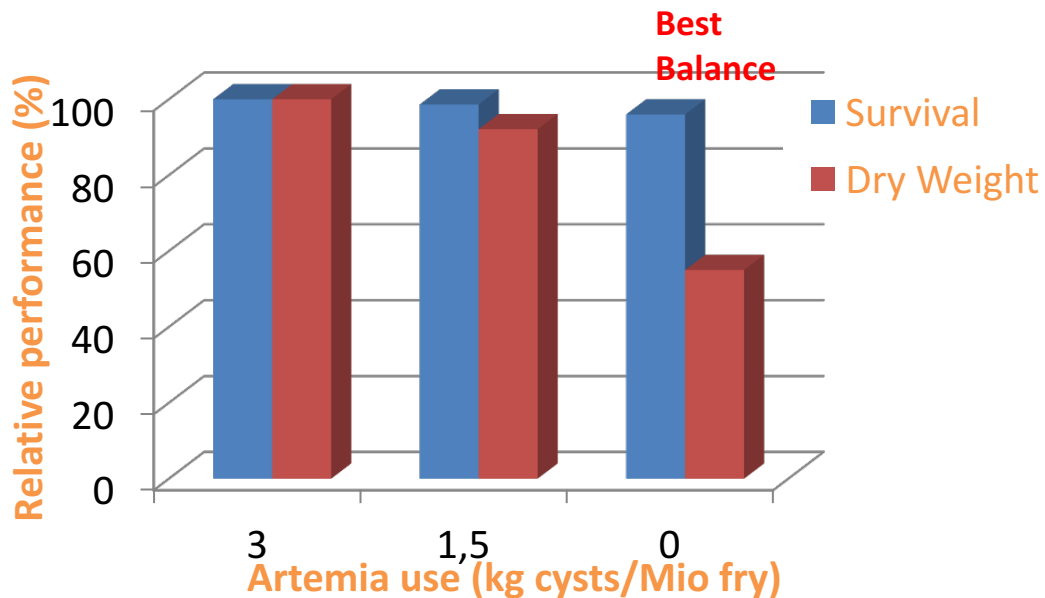
Series of
P. vannamei
larval trials
(N5-PL10)



Improved Nutrition

- **Best Balance**
 - Best Balance between live food and formulated feed FRIPPAK Fresh GOLD
 - Reduction of *Artemia* cyst consumption by factor 2

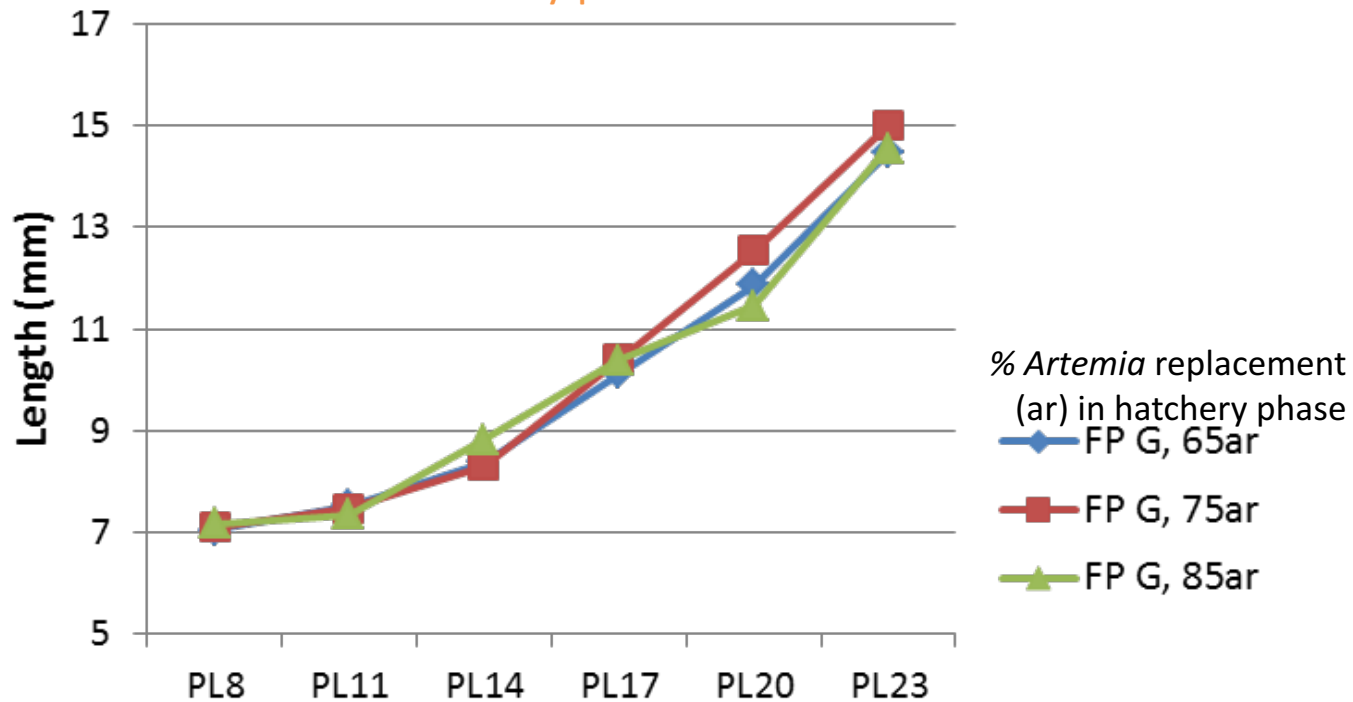
Possible *Artemia* reduction (with FRIPPAK FRESH Gold):
normal, decreased and zero *Artemia* cyst use



Improved Nutrition

Best Balance

Nursery growth after *Artemia* replacement in the Hatchery phase

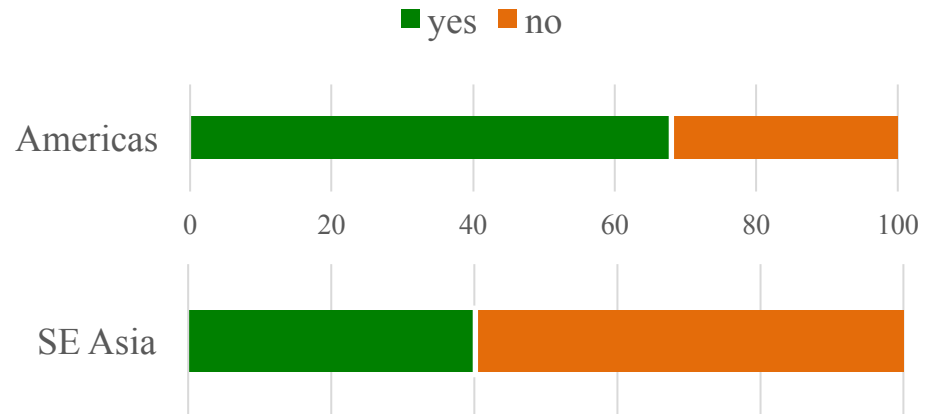


Improved Nutrition

- **Further stretching the balance**

- A slow gradual decrease in *Artemia* consumption statistics demonstrates that hatcheries world-wide learned to reduce their dependence on live food
- Hatcheries that have implemented *Artemia* reduction themselves have a stronger believe in low *Artemia* consumption protocols

Do you think that feeding regimes with reduced *Artemia* consumption can produce good postlarvae quality?

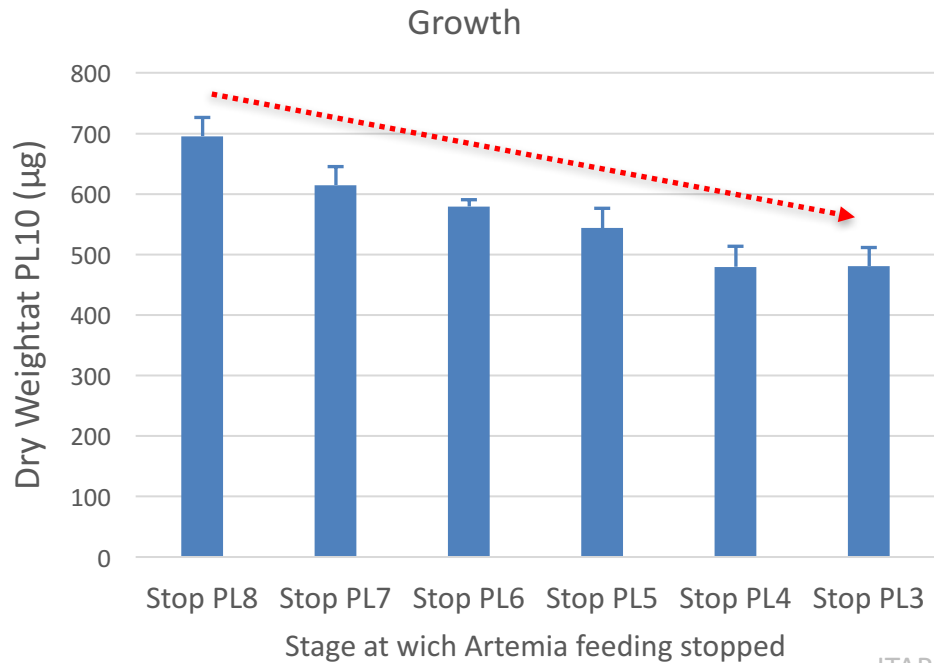


Improved Nutrition

Contribution of *Artemia*

Effect of *Artemia* replacement in late PL

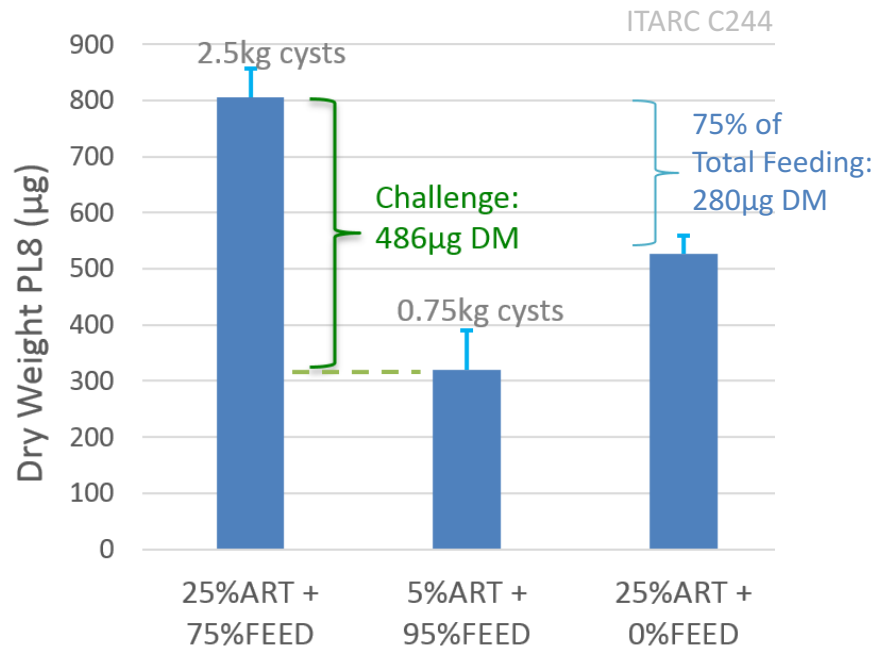
- Trial demonstrated the negative effect of stopping *Artemia* feeding in PL stages



Improved Nutrition

Contribution of *Artemia*

Artemia nauplii are more efficiently assimilated than formulated feeds



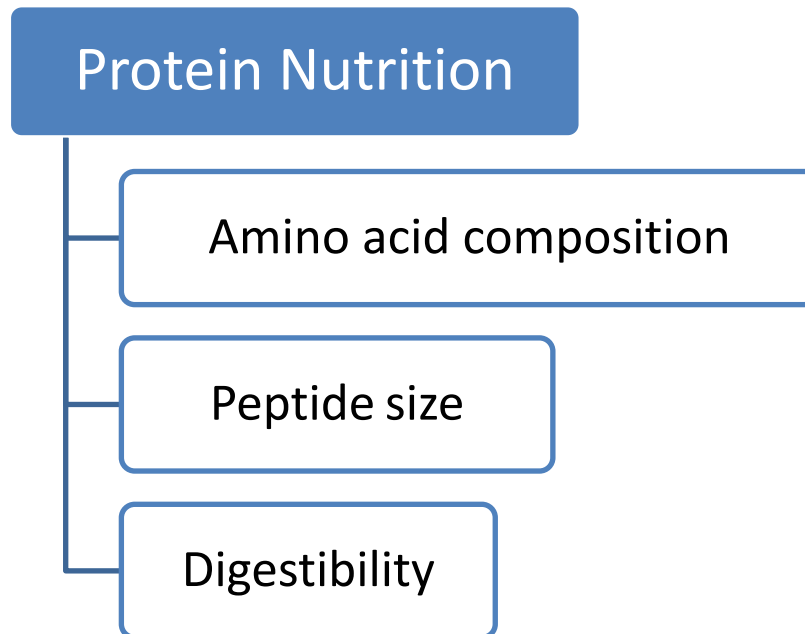
25% *Artemia* nauplii contributes more to larval growth and survival than 75% dry feed

Results confirmed by study J. Gambao-Delgado & L. Levay (2009), *Aquaculture* 297

Improved Nutrition

Growth

- As growth is mainly requiring protein synthesis, the focus in the current study was put on **protein nutrition**
- Earlier published studies with protein hydrolysate in diets for marine fish and shrimp larvae revealed the importance of amino acid balance.
- Presence of **different proteases during larval development** suggests age-specific digestive capacities.



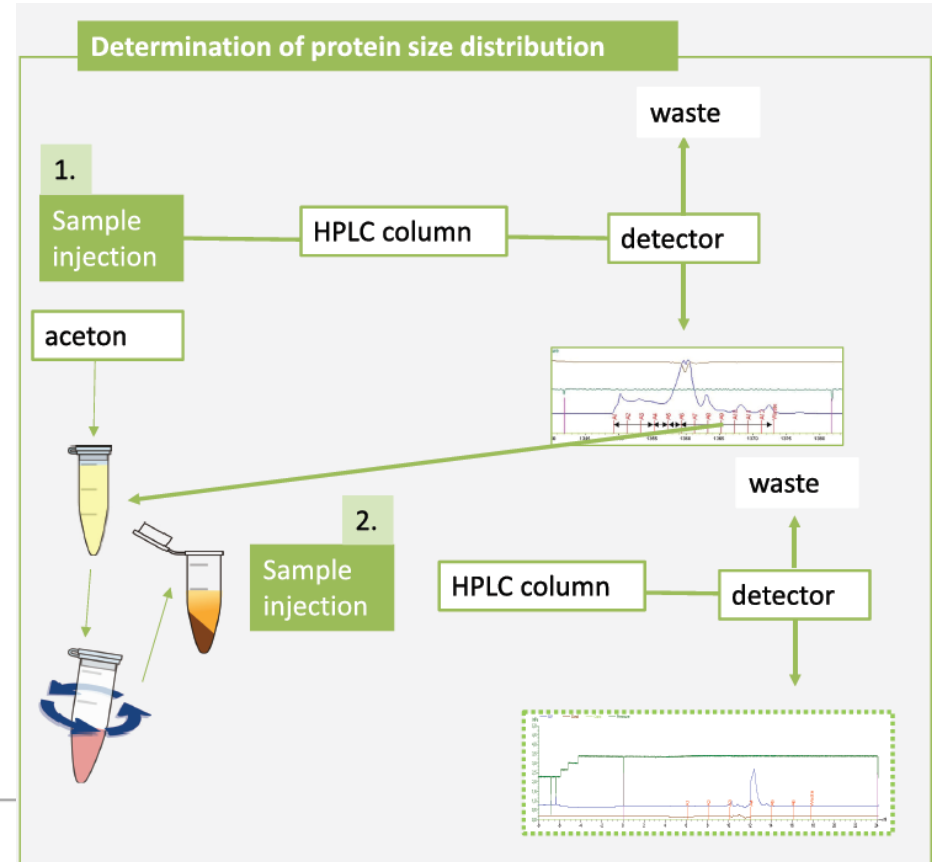
Protein nutrition

Peptide molecular weight distribution

→ Free amino acids, dipeptides and tripeptides are readily absorbed by enterocytes and enter the organism at higher rates than larger proteins.

Size Exclusion Chromatography (SEC)

SEC-screening of ingredients can clearly distinguish three groups based on protein size



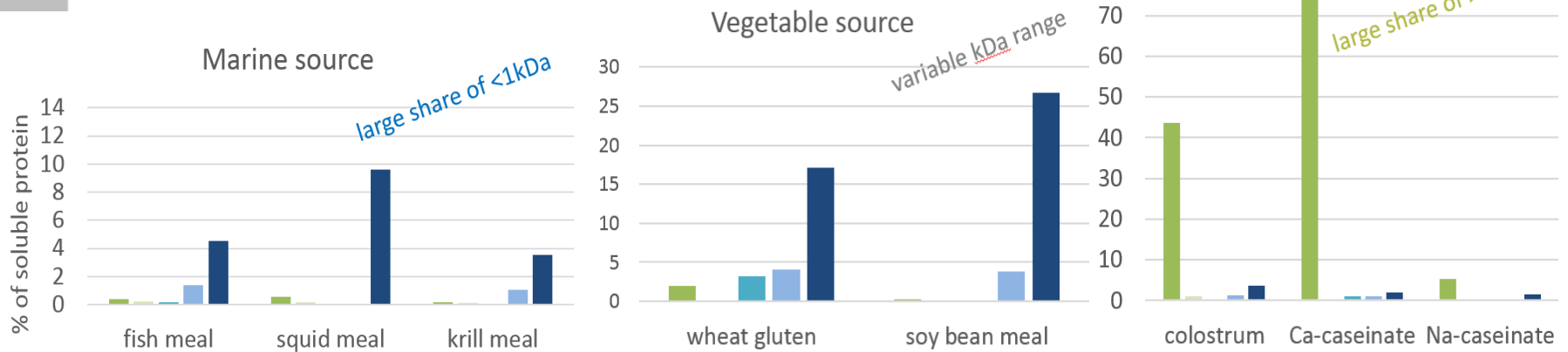
Protein nutrition

MW differences give the opportunity to formulate diets with different protein profiles

USING SIZE-EXCLUSION CHROMATOGRAPHY AS TOOL FOR PROTEIN SOURCE SELECTION FOR SHRIMP AND FISH LARVAL FEEDS

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Protein nutrition

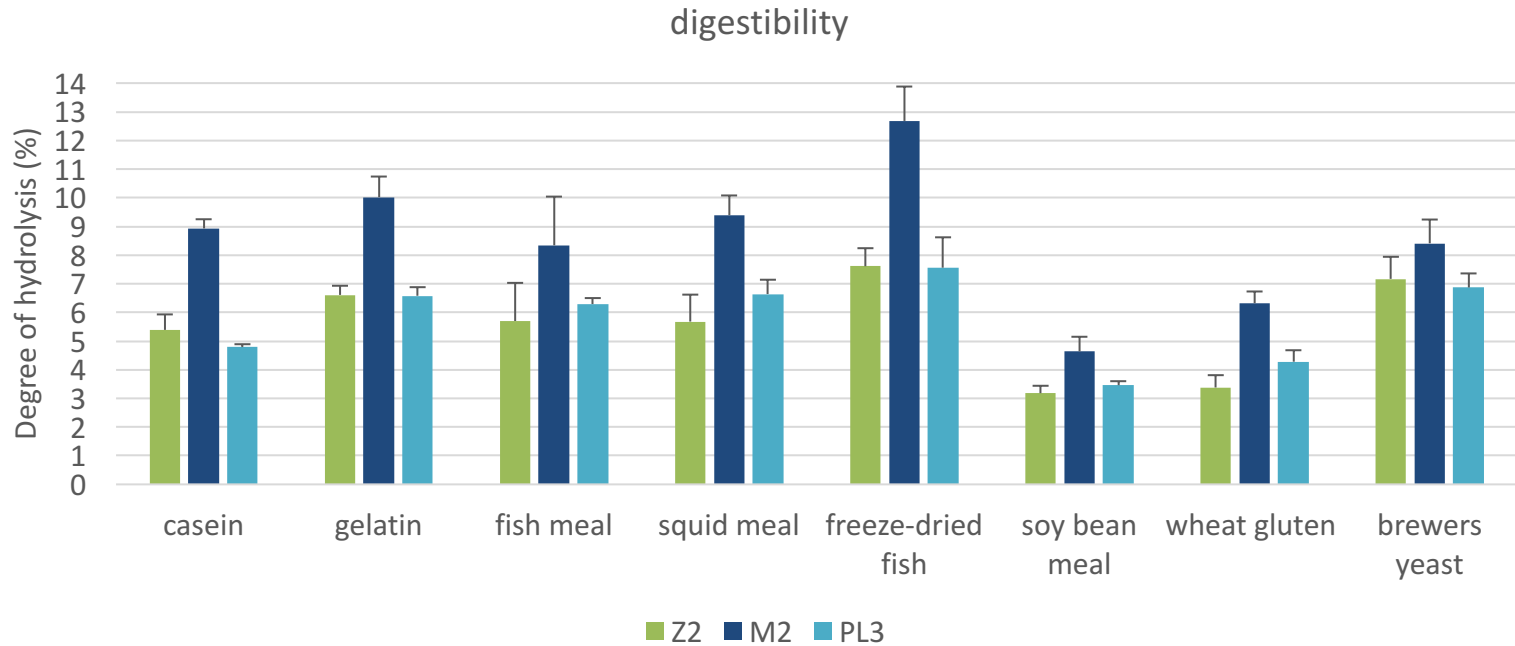
in vitro digestibility assay for *P. vannamei* larvae and PL's
(pH-stat determination of the degree of protein hydrolysis, %DH)

- Efficient feed formulation, processing and feeding practices
 - + suitable absorption/utilization of balanced amino acid pools
- New *in vitro* protocol developed in collaboration with Lemos & Yasumaru (University of São Paulo), using enzymes extracted from larval and postlarval *P. vannamei*



Protein nutrition

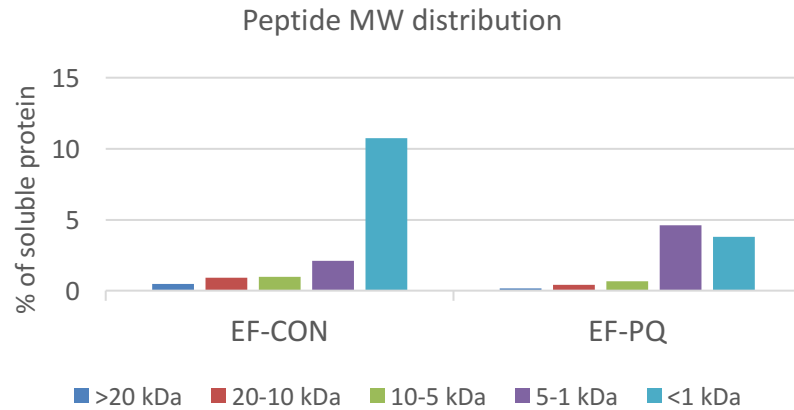
in vitro protein digestibility with *P. vannamei* enzyme extract



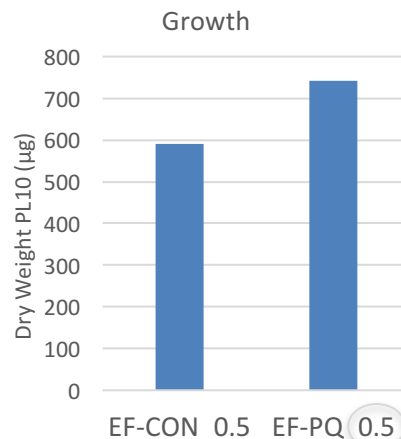
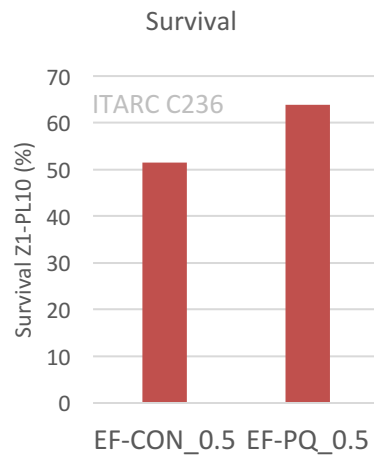
- Protein digestibility increased during larval development and reached maximum at Mysis 2 stage, followed by a decrease from Mysis 2 to PL3
- Vegetable terrestrial proteins were less digestible than marine animal proteins
- Distinction between animal marine protein sources & effect of processing
- Rapid screening of ingredients for the production of highly-digestible larval aquafeeds

Protein nutrition

Shrimp trial with feed containing highly-digestible, low molecular-weight, water-soluble peptide source (EF-PQ)



→ Experimental feed (EF) with inclusion of an ingredient selected on Protein Nutrition / Protein Quality (PQ)



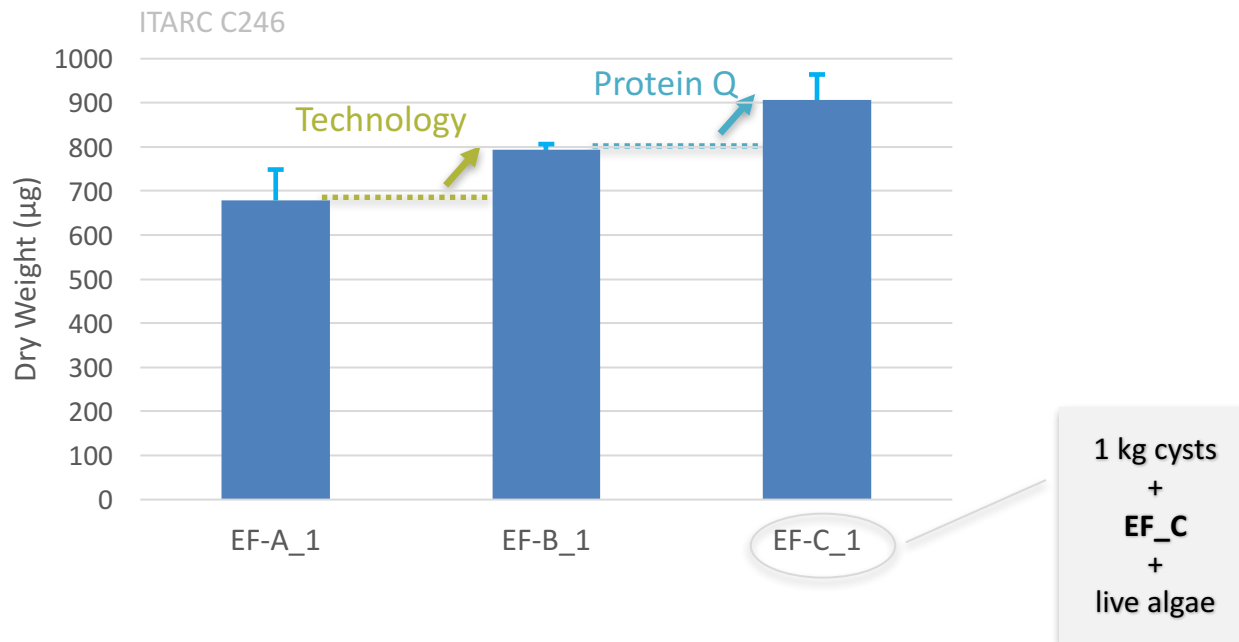
→ Increased survival and growth
→ EF-PQ enabled drastic reduction of *Artemia* consumption

0.5kg cysts consumed per M PL10

Improved Nutrition

Growth (individual Dry Weight)

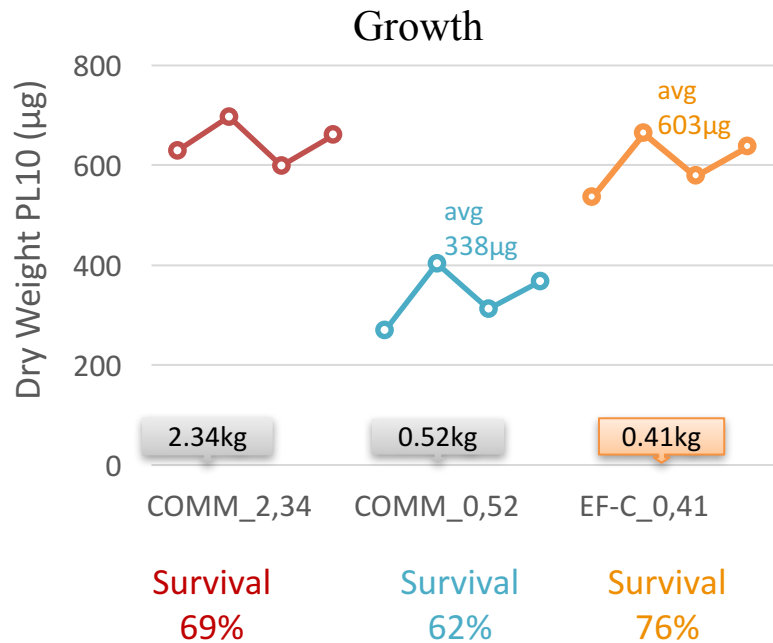
- Innovative feed development was obtained by combining new insights in protein quality with adapted feed technology.
- This technology was required to control the leaching of low-MW water-soluble nutrients such as amino acids, di- and tripeptides.



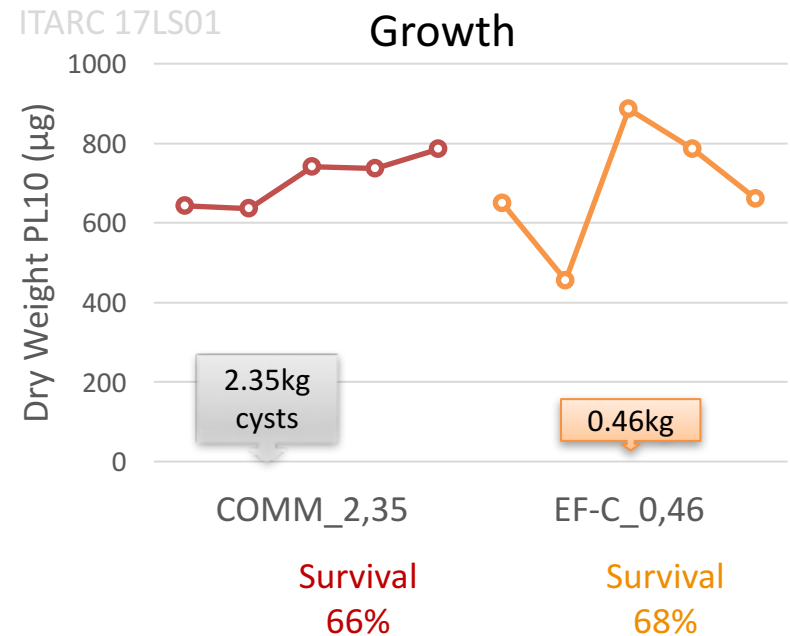


Innovative feed performance

Trial 1



Trial 2

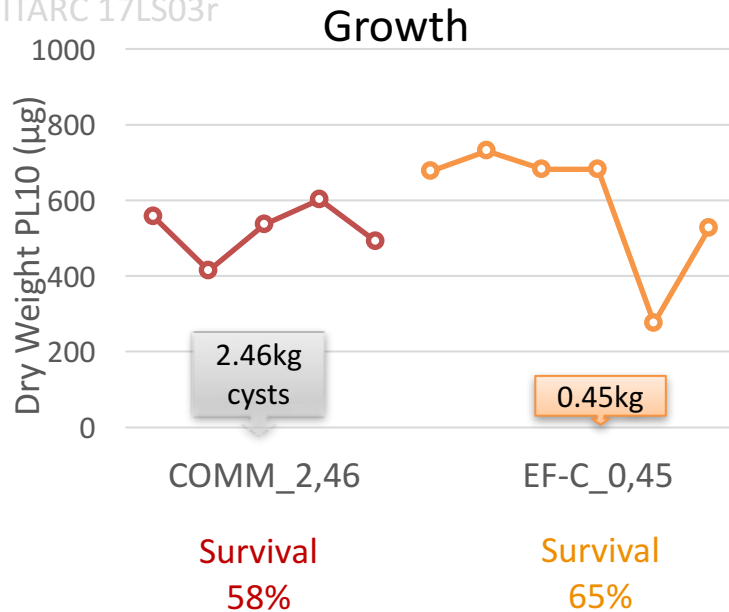


Repeatedly good survival and good growth results with newly developed feed EF-C, applying very low *Artemia* cyst consumption (less than 0.5kg) and adjusted feeding strategy.

Innovative feed performance

Trial 3

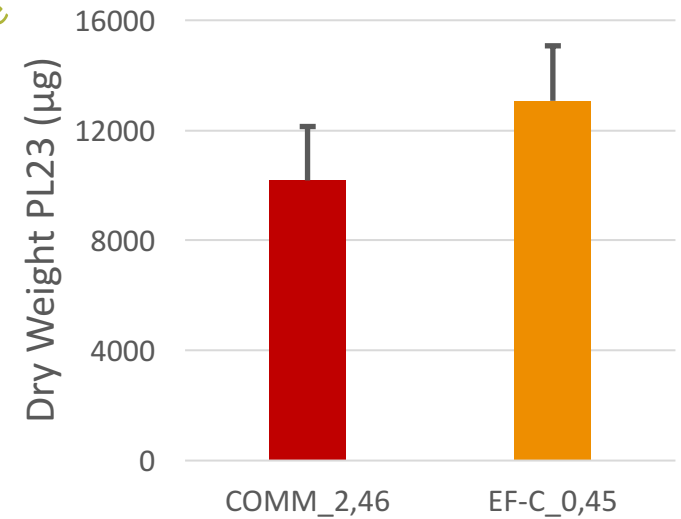
ITARC 17LS03r



Continued in
nursery phase



Follow-up trial in nursery tanks:
both treatments received same feed
during nursery culture



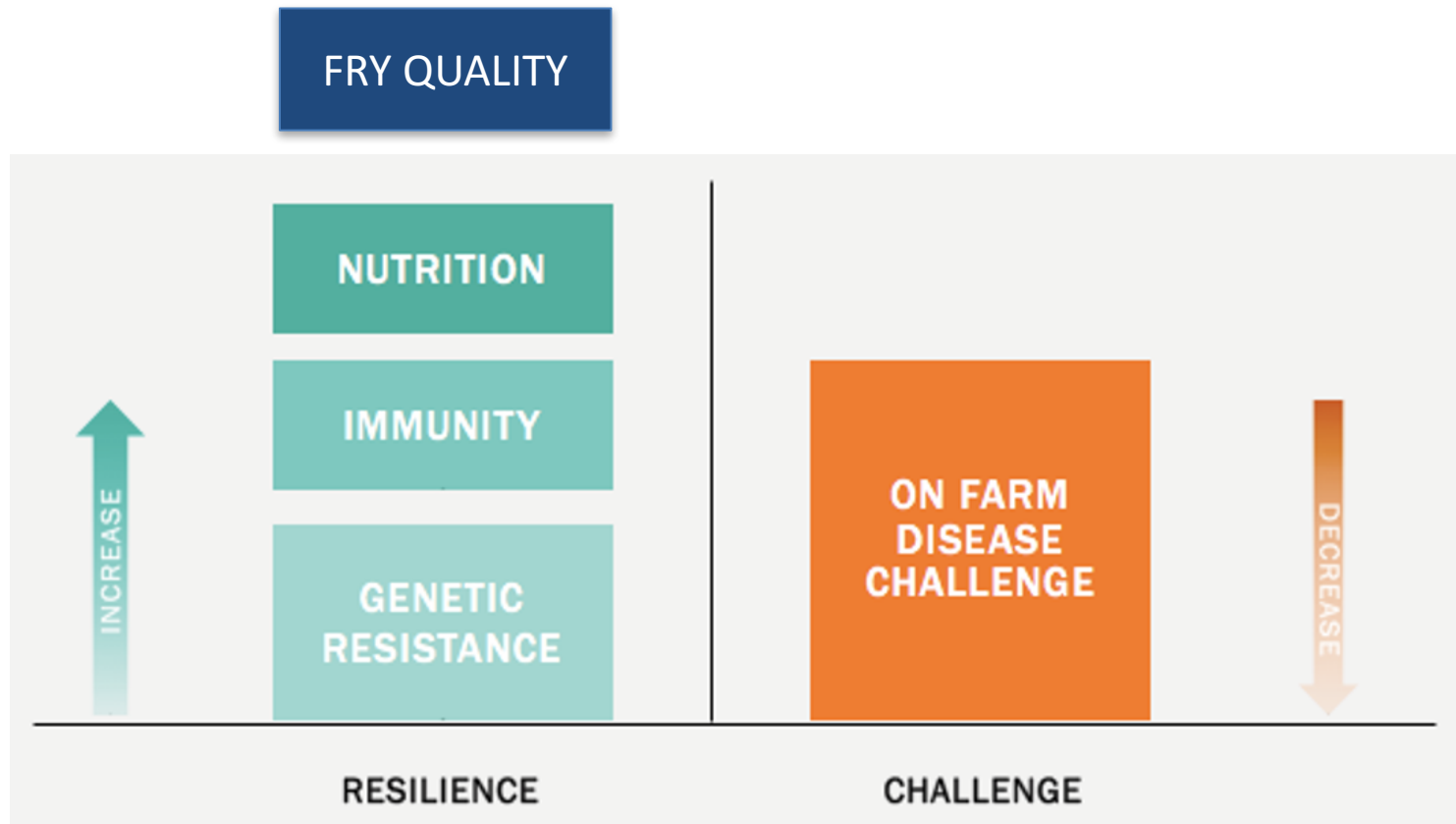
Good results with newly developed feed
EF-C are continued in the nursery phase

Feed EF-C produced larger/stronger PL's



Improved Nutrition & Health

Holistic approach



Improved Health

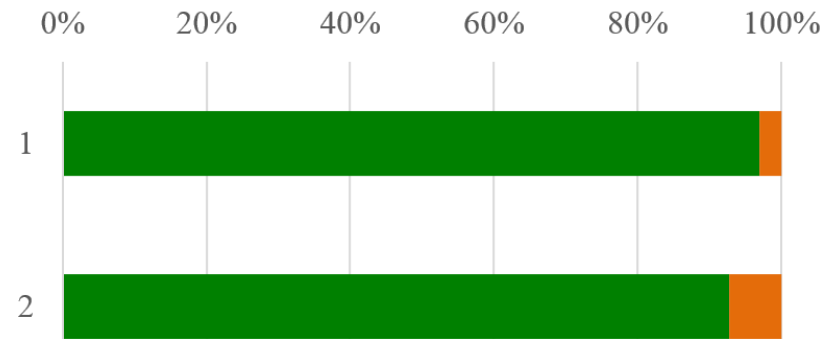
- A strong believe in the role of health products
 - The survey reflects the strong believe of hatchery managers in the benefit of health products for producing **stronger PL's** and reducing the risk of disease outbreak:

Vibrio suppressors, Health booster feeds, Probiotics

Do you think that ...

■ yes ■ no

1. microbial management in the hatchery influences PL quality?
2. there is a link between poor PL quality and the incidence of disease?

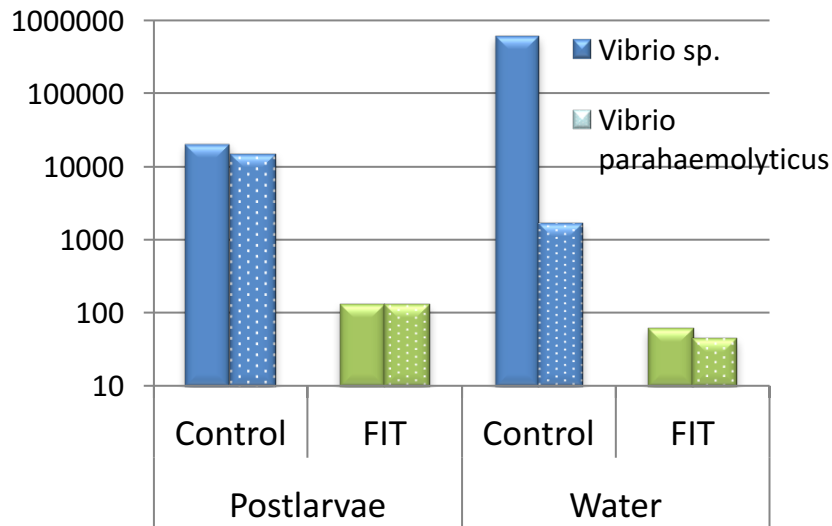


Improved Health

Vibrio suppressors / Increased robustness

Specific phytobiotic mix

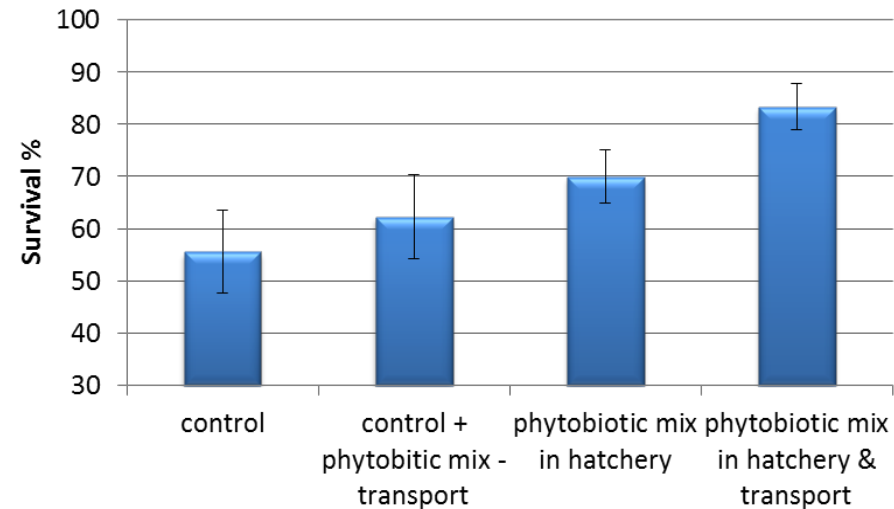
Vibrio load after 24h transport (PL10)



PL transport trial



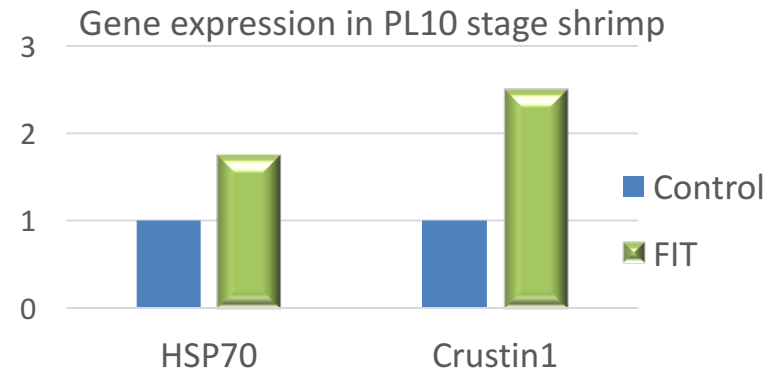
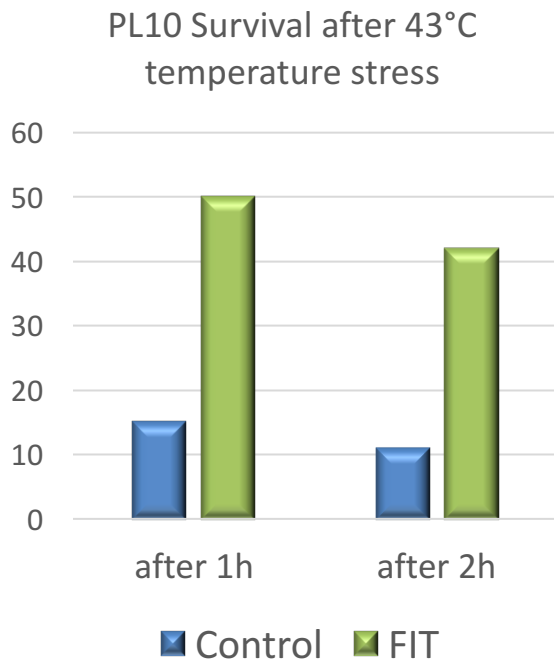
Average PL14 Survival during Salinity stress (1ppt-1h) - 4 days after transport



Improved Health

Vibrio suppressors / Increased robustness

Specific phytobiotic mix



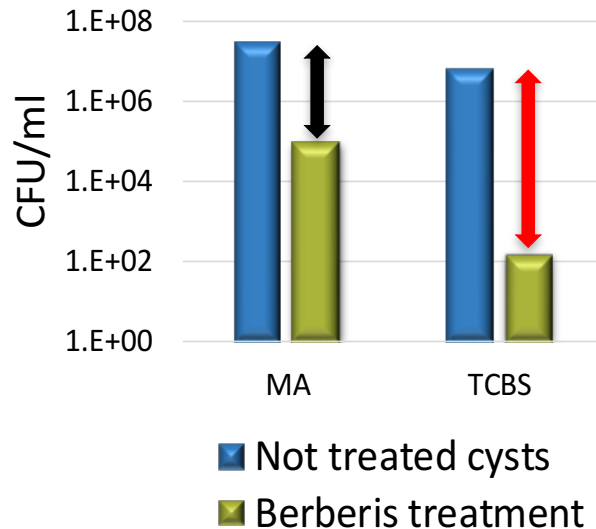
Upregulation of HSP70 RNA and Crustin1 RNA

Improved Health

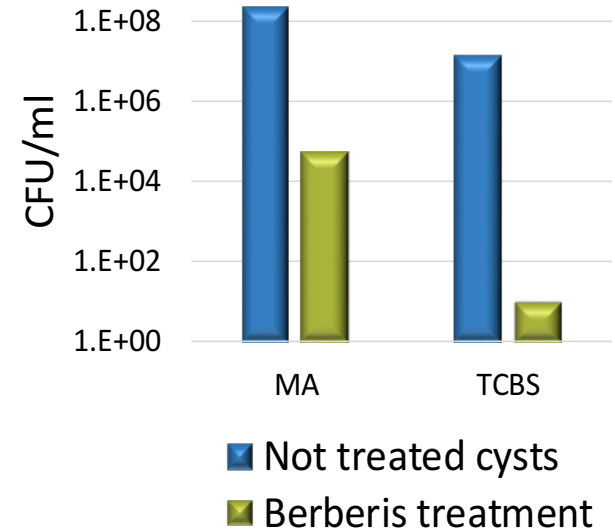
Vibrio suppressors

Applies selected plant extracts (incl. **Berberis**) to specifically suppress Vibrio development during the hatching process

Bacterial counts in HATCHING WATER (24h) of GSL cysts



1 year storage



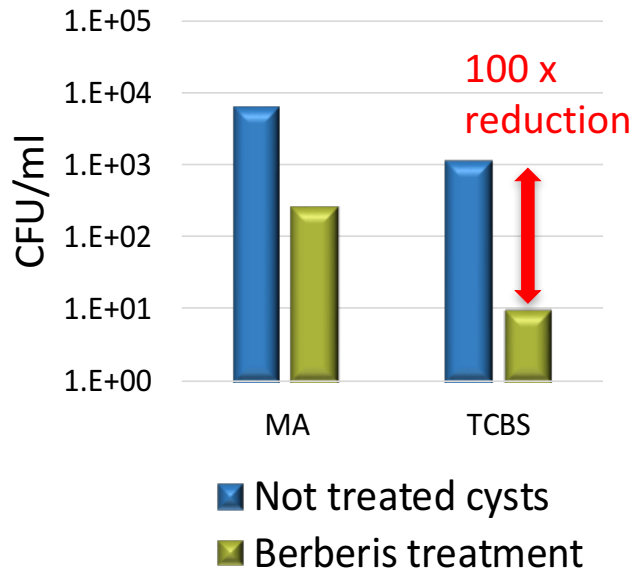
SPECIFIC action on *VIBRIO'S*

Bacterial reduction is STABLE during at least ONE YEAR

Improved Health

Vibrio suppressors

Bacterial counts on HATCHED NAUPLII (24h) of GSL cysts



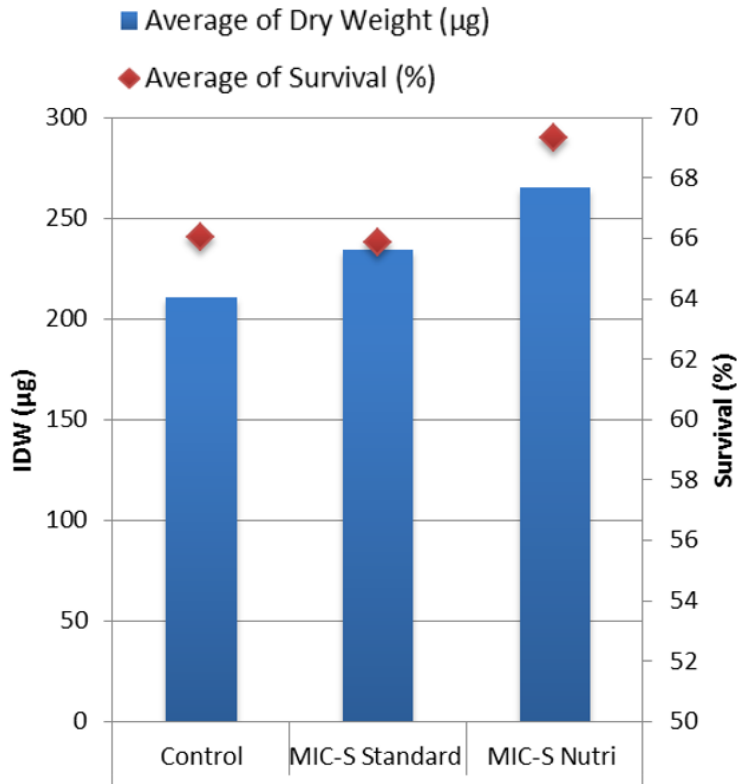
Artemia nauplii



Improved Health

Probiotics

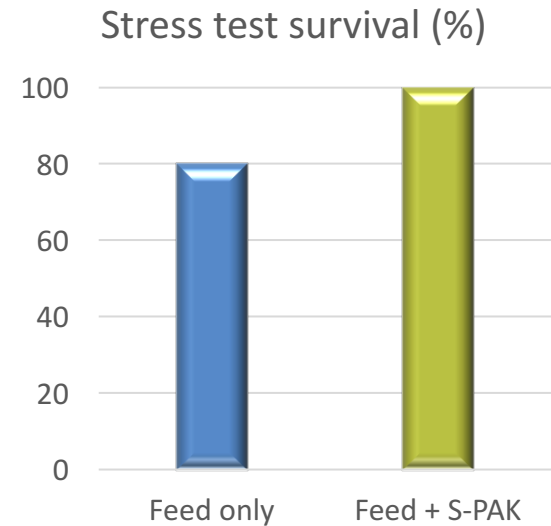
Positive effect on PL5 stage survival and growth



Health booster feeds

Positive effect on PL10 stress resistance

PL10 Survival (%) to a salinity stress test



PL quality through improved nutrition and health

- **Summary**

- Growing shrimp industry requires robust / high-quality postlarvae
- PL quality can be promoted through improved larval rearing techniques
- Innovative feeds have been developed based on new feed technology and continued efforts in the field of ingredient digestibility and protein nutrition
- These new feeds promote survival, growth and PL quality, also under low *Artemia* consumption protocols
- Health practices help producing robust and healthy PL's, hence assist in reducing mortalities during disease incidence in the farm

Improved PL quality → Improved grow-out performance

“Long-term stress and handling stress negatively affected growth, molting and feed consumption in *L. vannamei* juveniles.”

(Mercier et al. 2009)

Higher survival to a PL stress test is associated to:

- “greater survival during stocking”

(Fegan 1992; Racotta et al. 2004)

- “better survival and growth during grow-out”

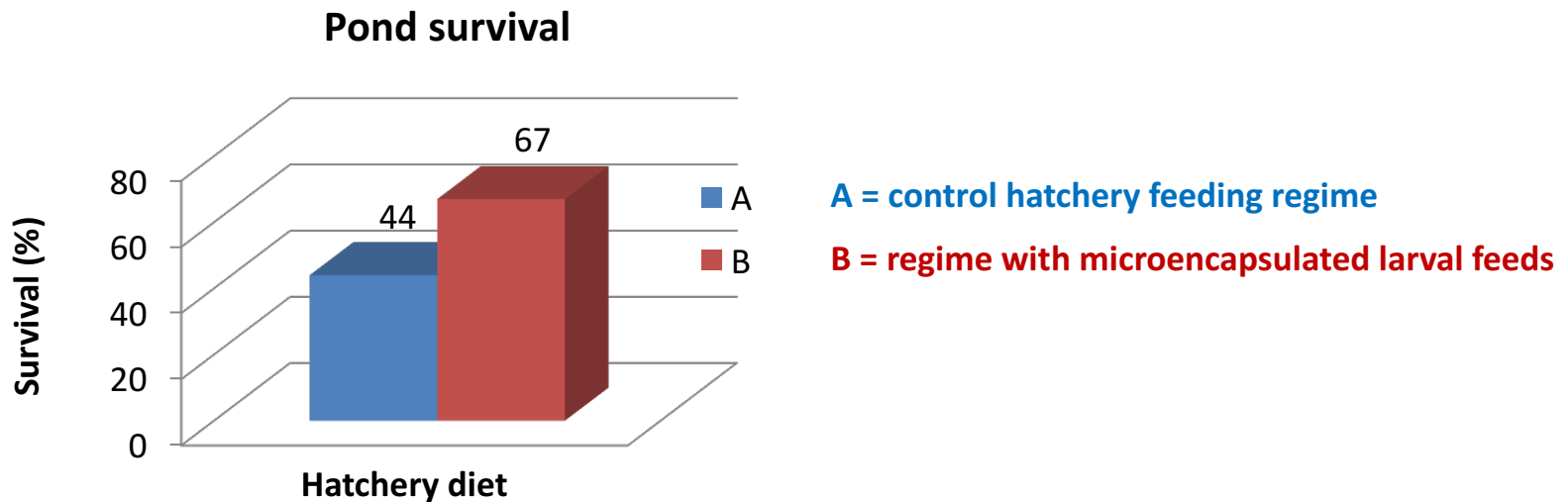
(Aquacop et al. 1991)



Improved PL quality → Improved grow-out performance

Grow-out trial (Ecuador):

- PL's originated from the same hatchery received two different larval feeding regimes (A & B) → 12 shipments, 8.5 million PL → stocked in 0.3 ha ponds at the grow-out farm and harvested after 45 days



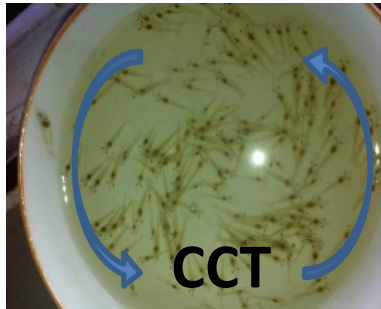
An analysis of the survival of hatchery reared *Penaeus vannamei*, Boone, larvae.
H. Lucien-Brun, A. Aguilar, J.A. Salvador and Daniel O’C Lee

Improved PL quality → Improved grow-out performance

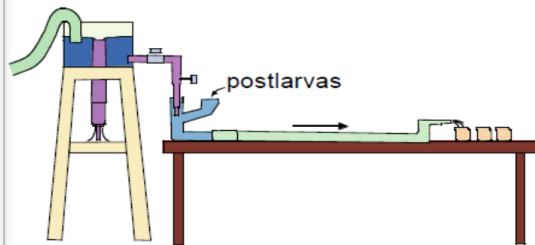
Experiment (CENAIM, Ecuador): **Growth** increased

... with 17% with PL's that better resisted osmotic stress test (OST)

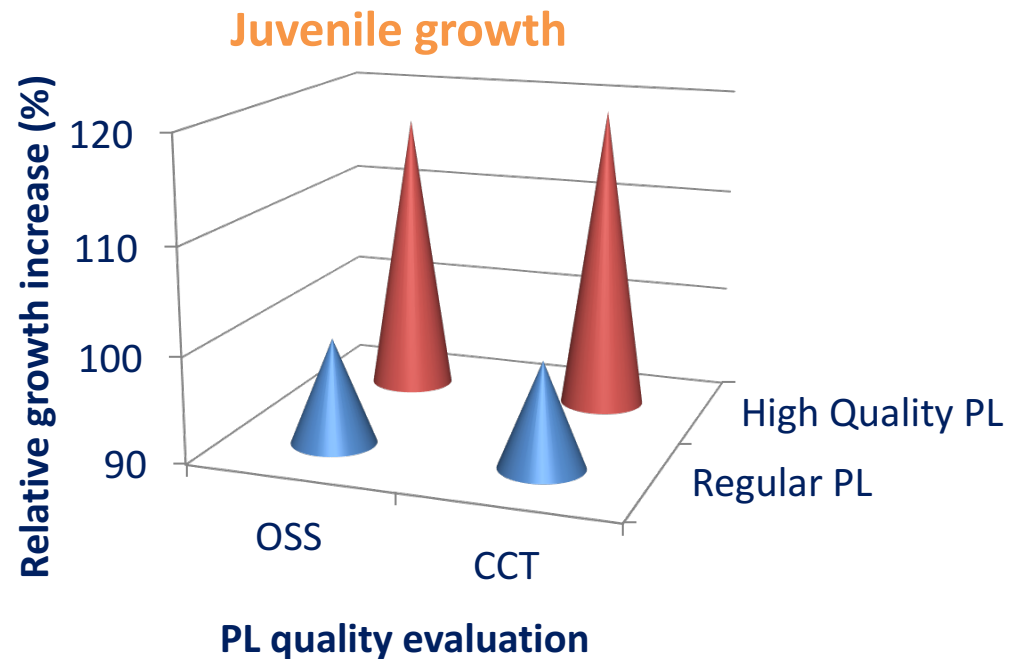
... with 19% with PL's that could swim counter-current



Counter-current test (CCT)



Naessens et al. 1995



Improved PL quality → Improved grow-out performance

- **Effect of stocking high quality PL's in grow-out ponds**

Effects in the first month after pond stocking

- improved survival rate and increased growth
- reduced transfer of pathogens to the ponds
- allows a good initial count of the number of PL stocked
- improved control over juvenile stocking densities → more accurate calculation of feeding quantities

Long-term effects during grow-out

- improved survival rate, increased growth, better FCR, better disease resistance
- more accurate calculation of feeding quantities
- ➔ increased final pond crop yield

Assumed cost benefit of stocking improved PL quality

Hypothetical cost benefit by stocking better quality postlarvae:

Shrimp grow-out pond (1 ha) stocked with 1 Mio PL's (harvest 15 g shrimp)	Regular PL quality	Improved PL quality	Difference (%)
Survival transport (%)	91	95	+4
Survival pond (%)	75	80	+7
Growth rate (g/wk)	1,21	1,25	+3
Culture periods (days)	89	85	-4
Feed cost (USD)	24413	23687	-3
Additional costs (USD)	19207	19207	0
Total cost (USD)	43620	42888	-2
Cost/kg shrimp (USD)	2,84	2,43	-14
Yield/pond (USD)	76795	88343	+15
Profit/pond (USD)	33175	45455	+37

PL quality through improved nutrition and health

- **Summary**

- Growing shrimp industry requires robust / high-quality postlarvae
- PL quality can be promoted through improved larval rearing techniques
- Innovative feeds have been developed based on new feed technology and continued efforts in the field of ingredient digestibility and protein nutrition
- These new feeds promote survival, growth and PL quality, also under low *Artemia* consumption protocols
- Health practices help producing robust and healthy PL's, hence assist in reducing mortalities during disease incidence in the farm
- Stocking high quality PL's in grow-out ponds has proven beneficial effect on survival and growth in the weeks after pond stocking
- Assumed long-term effects of stocking high quality PL are increased crop yield and cost benefit for the grow-out farmer

Take-away-message

Do not compromise hatchery performance by cutting costs on necessary feeds, health products and microbial management.

Instead, invest in optimizing PL quality from the start of hatchery and get higher net return at pond harvest.

Thank you!

