Vol 7 Issue 1 2019

HatcheryFeed

FEED & NUTRITION FOR EARLY LIFE STAGE AND BROODSTOCK AQUATIC SPECIES

Advances In Octopus Production

- Nutritional Requirements of Pike Pearch Larvae and Fry
- Developments in Seriola Culture
- Microbes Rule the Word - and your Larval Tank Too

HatcheryFeed

FEED & NUTRITION FOR EARLY LIFE STAGE AND BROODSTOCK AQUATIC SPECIES

From the publisher

We start 2019 with a new look and a new editor. I am pleased to introduce Lucía Barreiro, who comes to Hatcheryfeed with a strong background in aquaculture with a B.S. in Marine Biology, M.S. in Aquaculture and practical experience in aquaculture production, hatchery management, research and project management. In addition to her role as editor of Hatcheryfeed, she also works on the Aquafeed magazine and is responsible for the Aquafeed weekly newsletter.

We also start a new regular column by Aquaculture Ghent University, which I am sure you will find interesting and informative.

Suzi Dominy,
Publisher Aquafeed.com, LLC

Suzi Dominy

Lucía Barreiro

Contents

Contents

To read previous issues in digital format or order print copies,visit:
http://www.hatcheryfeed.com/hatcheryfeed-magazine/

Index to Advertisers

We are grateful to the following companies for sponsoring this issue of the magazine. Their support allows us to make our publications available without charge. We thank them for partnering with us to support the development of our industry through education and information

CONTACT US

Editorial:
editor@hatcheryfeed.com

Advertising:
sales@hatcheryfeed.com

Technical Feed Consulting:
consulting@aquafeed.com

General Enquiries:
info@aquafeed.com

Hatcheryfeed Magazine is
Published by aquafeed.com LLC.

Kailua, Hawaii 96734, USA.

www.aquafeed.com

www.hatcheryfeed.com.

SUBSCRIBE

Digital editions are free to industry. You may also purchase print copies.

DOWNLOAD

SUBSCRIBE

News Review

North American hatchery to raise Bluefin tuna on soy

A new grant from the Foundation for Food and Agriculture Research (FFAR) augments ongoing support from the Illinois Soybean Association (ISA) checkoff program and will allow Ichthus Unlimited, LLC, to establish a hatchery in the San Diego Bay area. This will be the first tuna hatchery in North America and the third bluefin hatchery in the world.

Alejandro Buentello, president of Ichthus Unlimited, LLC, will lead the hatchery project to cultivate Pacific bluefin tuna eggs, raise them to juvenile fish and distribute them to tuna farms to be raised to market maturity. This aquaculture system will improve the sustainability and quality of tuna production.

“High global demand increases tuna value and induces overfishing of wild stocks,” Buentello says. “The tuna ranching industry is constrained by a stringent quota system that limits the amount of wild tuna they can catch to stock in oceanic cages. With ISA support, we successfully developed soy-based feed that can be commercially manufactured.”

The hatchery will allow tuna to be raised with sustainable feed from very early growth stages. According to Mark Albertson, director of strategic market development for ISA, the program has been funding sustainable feed research with this goal in view. For the past three years, Buentello has led ISA-funded research to develop sustainable soy-based diets for tuna. The nutritionally dense soy-based diet improves feed conversion rates, reduces waste and improves meat quality. And it is made from sustainable, renewable ingredients.

The ISA-funded research tested various soy-based diets for larval Atlantic bluefin tuna in Spain, where survival rates improved at least 30 percent compared to other diets. Juvenile yellowfin tuna in Panama land-based facilities also tested formulated feed options. Building on these experiences, trials with mature, ranched Pacific bluefin tuna in ocean net pens in Mexico confirmed the viability of the soy-based diet. The formulated diet decreases the feed conversion ratio from 28:1 with wild-caught sardines to 4:1, and reduces the amount of fishmeal and fish oil in feed by tenfold.

“Soy protein is a complete protein that replaces fishmeal in diets for many aquatic species and has become the top ingredient in aquaculture feed,” says Albertson. “ISA filled a research gap in alternative protein research for tuna that existed because of the species’ complexity. We’ve laid the foundation to use soy-based feed from early development through maturity.”

The ISA checkoff program research project brought together many partners to improve tuna aquaculture sustainability. Texas A&M and Kansas State universities supported research elements and evaluations and a San Diego-based factory produced feed for market-scale trials. Several competing feed companies contributed raw materials, key ingredients, blending facilities and other resources.

The new hatchery will continue this trend of industry collaboration, as Ichthus Unlimited works with other tuna hatcheries, FFAR, ISA, Texas A&M University, the Spanish Institute of Oceanography and feed manufacturers.

“We have developed manageable solutions for tuna production based on strong science,” says Buentello. “We are proud to work with forward-thinking leaders to develop truly sustainable hatch-to-harvest tuna farming.”

FDA approves import of AquAdvantage salmon eggs

The U.S. Food and Drug Administration (FDA) lifted the import alert allowing AquaBounty to start farming AquAdvantage Salmon in Indiana facilities. The FDA's approval of the application related to AquAdvantage Salmon followed a comprehensive analysis of the scientific evidence, which determined that the GE Atlantic salmon met the statutory requirements for safety and effectiveness under the Federal Food, Drug and Cosmetic Act. However, in 2016, Congress directed the FDA not to allow into commerce any food that contains GE salmon until it issued final labeling guidelines for informing consumers of the GE salmon content in the food. The FDA complied with this requirement by implementing an import alert in 2016 that prevented GE salmon from entering the U.S.

Sylvia Wulf, Chief Executive Officer of AquaBounty, stated, "we are delighted that FDA has lifted the import alert, which will allow AquaBounty to begin producing and marketing AquAdvantage salmon in the United States. As FDA notes in this announcement, our salmon was approved by the agency over three years ago based upon a very comprehensive science-based review process, which established that our salmon was safe, nutritious and environmentally sound and met all other regulatory requirements. We will immediately start the process to import AquAdvantage eggs from our hatchery in Canada to begin grow out at our Indiana facility."

AquaGen buys Scottish Salmon Hatchery

Salmon breeder and egg supplier AquaGen has signed a deal to buy Scottish Sea Farms' freshwater hatchery at Holywood near Dumfries. This is a long-term strategic investment that will further improve fish welfare in Scotland. The acquisition follows a successful trial production of eggs under license in fall 2018 and will enable the company to offer Scotland's salmon farmers a reliable supply of eggs from locally farmed AquaGen broodstock. It will also facilitate a targeted breeding program to identify the genetic and biological traits most suited for good performance in Scottish farming conditions, resulting in robust fish stock and a market high-quality product.

AquaGen AS Chief Executive Officer, Nina Santi said, "we are committed to providing our customers in Scotland with a secure supply of eggs and this latest investment opens up the possibility for supplying these eggs from locally-grown broodstock. We're planning a series of upgrades to the existing facilities at Holywood using Scottish suppliers as much as possible. Then, we will go into full production later this year. Deliveries will be from November to June initially and we hope to extend to year-round production of up to 50 million eggs annually."

Unlike coastal hatcheries, the four-acre inland hatchery at Holywood uses groundwater drawn from a series of bore holes. This system is known for its biosecurity, quality and constant temperatures that are well-suited for egg production.

Scottish Sea Farms' Head of Fish Health Ralph Bickerdike said, "this is a hugely promising development for Scotland's salmon farmers, bringing world-leading breeding expertise and technologies to bear on home-grown broodstock so that their offspring can be adapted to specifically suit the Scottish marine environment. This, in turn, will bring a whole host of further improvements in terms of fish welfare and product quality."

Medical technology applied to salmon selection

Each year SalmoBreed arranges a test slaughter on half and full-siblings of the next generation of broodstock in their breeding program. This gives access to important information that is used to rank individual broodfish according to their expected performance on various slaughter and quality traits. In traditional test slaughters, SalmoBreed manually dissects, weighs, scores, records and samples thousands of fish.

SalmonBreed will obtain for the first time phenotypes from a mobile medical computed tomography (CT) scanner. CT scanning is a non-destructive method originally designed to measure the composition of human tissues. By using this technology on salmon, it is possible to estimate yield using 3D image analysis of the x-ray absorption properties. Since different tissues have different absorption properties, the tissue distribution can be extracted using image analysis software. This approach can significantly reduce the cost of labor and materials for the test slaughter and remove the operator dependence when performing manual filleting. Virtual cleaning of the fish is done by locating the different organs and removing them using advanced image analysis.

The CT technology was only previously tested in a pilot project in 2018 by CompleteSCAN, a FHF-funded project. This year the CT scanner will replace traditional manual dissection and is expected to increase accuracy in data collection.

In addition to broodstock from SalmoBreed, the company is conducting similar tests on fish from StofnFiskur and SalMar who hold the Rauma strain. A total of 10,000 fish from the three strains were PIT-tagged and put to sea in the autumn of 2017 at the Institute of Marine Research (IMR) facility in Austevoll municipality. Growth, mortality, sea-lice attachments and various health parameters have been previously recorded, and tissue samples for DNA analysis has been collected.

The fish that originate from StofnFiskur have half and full-siblings in its nucleus located in their full cycle land-based facilities in Iceland. Siblings from the same fish families are also currently reared in Denmark and Chile. The test slaughter gives the opportunity to reconfirm the high genetic correlation between growth measured on land in StofnFiskur’s breeding nucleus and seawater growth in Norway.

FISHBOOST project up one level in breeding for six fish species

The EU supported project FISHBOOST has concluded establishing a solid knowledge base and developing tools and techniques to advance selective breeding to the next level for the six main finfish species in European aquaculture, Atlantic salmon, rainbow trout, gilthead seabream, European seabass, turbot and common carp.

An important goal was to enhance the innate protection against fish diseases in farmed species. Especially for this group of traits, FISHBOOST partners have developed genomics tools and techniques for improving breeding programs such as RAD sequencing technology to genotype cheaply and create methods to reduce genotyping costs for genomic selection, by pooling DNA from individuals with extreme phenotypes in the reference population. These results may lead to wider scale implementation of genomics in aquaculture breeding programs with the ultimate aim to reduce disease incidences.

For production traits, focus has been to develop tools that record production traits indirectly. This is done by recording morphological traits of fish on live fish, for example fillet yield and lipid percentage. This is important to increase genetic gain for these traits in the breeding programs, and it contributes to improvement of the human use of animals for research purposes (3R) in the European aquaculture industry.

Software has been developed for fish breeders to manage inbreeding in the selection and mating steps in a breeding program. Other software selects strains or individual fish in strains to form a base population for breeding.

Bio-economic models have been developed for the FISHBOOST species. These models can be used to calculate economic values for production efficiency traits, in order to select for the most important traits under different production systems. The results can also be used to quantify the effectiveness of breeding in an aquaculture production system.

UK researchers launch AquaLeap project

The £1.7 million AquaLeap initiative will focus on four key species that have substantial economic and environmental importance for the UK as the European lobster, European flat oyster, lumpfish and Atlantic salmon. University researchers will work closely with industry partners to identify sustainable solutions to current challenges facing aquaculture production, including significant diseases.

The interdisciplinary consortium is led by the University of Edinburgh's Roslin Institute in partnership with the Universities of Aberdeen, Exeter and Stirling, and the Centre for Environment, Fisheries and Aquaculture Science (Cefas). The commercial partners are Hendrix Genetics BV, Xelect Ltd, The National Lobster Hatchery, Tethys Oysters Ltd., and Otter Ferry SeaFish Ltd.

Teams will use cutting-edge genetic sequencing technologies to identify DNA markers that are linked to economically important traits, such as disease resistance or growth rate. This information will help develop and apply new tools to improve breeding programs for these valuable species. Experts will also develop gene-editing techniques to understand genes controlling resistance to diseases and explore possibilities of using this technology to speed up stock improvement.

Ross Houston, professor of The Roslin Institute, said, "well-managed program of domestication and breeding have a large and mostly untapped potential for improvement in aquaculture production. AquaLeap will focus on developing and applying genomic tools to selective breeding of several important aquaculture species."

Hendrix Genetics launches new products for Chilean salmon industry

Hendrix Genetics has developed different products adapted to different Chilean regions: genotypes show differences in performance in different traits, caused by the environment. This is the so-called “genotype by environment” effect (GxE). Especially for Atlantic salmon in Chilean regions XI and XII, harvest weight differs greatly between families. This means that for optimal salmon production in region XII, fish should not be selected based on performance data from region XI and vice versa. When selecting the 10% best families for production in region XII based on performance in that region, an average gain of 802 grams can be realized compared to selecting families based on data collected in region XI.

Based on their centralized breeding program in Catripulli in combination with numerous sentinel groups in different locations under different conditions, Hendrix Genetics has optimized their selections for Atlantic salmon in the different Chilean regions using specific requirements which let them launch two new products.

EXPLORER, which was made for Magallanes. EXPLORER will be available from April 2019 in limited quantities. Selected from females that are proven to be late maturing, Explorer is protected against early maturation. With challenging growing conditions, Region XII requires a different selection of families to produce the right eggs.

CHALLENGER eggs are especially selected to perform in region X and XI. Based on a continuous flow of new data on growth and harvest performance, new breeding programs based on genomic selection, sentinel groups and survival test deliveries showed the desired results, outperforming the competition.

Proviron offers all year round CHAETOPRIME for shrimp and shellfish

Proviron is the sole producer of freeze dried Chaetoceros focused on shrimp and shellfish hatcheries. The company has been running in continuous production since the start and output results are very satisfactory. This means that they have passed the start-up phase and are able to provide consistent high quality product all year round. ChaetoPrime is produced in a closed vertical panel photo-bioreactor system. It is further processed by filtration and freeze drying.

ChaetoPrime offers a constant high nutritional quality. It is composed of easily re-dispersed single and nicely separated cells remaining in the water column for an extended period after rehydration. It is a pathogen-free microalgae and is available off the shelf.

ChaetoPrime is an algae for the early larval stages of shrimp (zoea and mysis) and shellfish species. This diatom has a balanced nutritional profile containing all essential HUFAs such as EPA, DHA and ARA.

Recent advances in the culture of *Octopus vulgaris* paralarvae

By Pedro Domingues, IEO

Octopus vulgaris juvenile (0.4 - 0.6 g, 100 days old) produced at the IEO under new patented culture protocol. Photo: IEO.

The common octopus (*Octopus vulgaris*) is a highly valued species for aquaculture. Octopus fisheries have been overexploited for the last decade, forcing governments to regulate fisheries, which increases the importance of cephalopod aquaculture. *O. vulgaris* is an excellent candidate for aquaculture due to its short lifecycle, rapid growth and good feed conversion rate (Vaz-Pires *et al.,* 2004).

Octopus Culture Barriers

The major bottleneck of *O. vulgaris* culture is the high mortality during the paralarval stage. Several studies have focused on this issue and even though specific causes of high mortality remain unidentified, it is likely that nutrition, and to a lesser extent, zootechnical issues, are among the most important factors.

Cephalopods have high levels of total protein in the mantle (75-85% DW) (Iwasaki and Harada, 1985), mainly protein and amino acid (AA) metabolism, therefore protein-rich diets are required for this species (Lee, 1994) with high AA requirements (Houlihan *et al.,* 1990). Total and free AA composition of *O. vulgaris* paralarvae and wild octopus juveniles was assessed by Villanueva *et al.* (2004), in order to evaluate the possible requirements of this species during early feeding.

The high mortality during the first 30 days of paralarvae is the main barrier to commercial production of this species (Iglesias *et al.,* 2007; Villanueva & Norman, 2008). Some authors have successfully reared a small number of paralarvae up to juveniles and even subadults (Iglesias *et al.,* 2004; Carrasco *et al.,* 2006). Iglesias et al., 2004 obtained dry weight of 9.5 mg and a survival rate of 31.5 % at 30 and 40 days respectively, using *Artemia and Maja* zoeae as prey. Later, Carrasco *et al.* (2006) obtained similar results with the same preys but a different rearing system.

The standard and commonly used protocol based on juvenile *Artemia* enriched with microalgae in combination with zoeae and green water technique with microalgae species as *I. galbana, Chlorella* sp. and *Chaetoceros* sp. (Iglesias *et al.,* 2004) has been inadequate. Furthermore, the use of zoeae is not viable at large scale. Navarro and Villanueva, 2003 suggested that co-feeding of enriched *Artemia* with formulated micro-diets could meet nutritional requirements of octopus paralarvae, but this is almost unachievable without a basic biological and nutritional physiology approach.

IEO's Patent

Juveniles of *Octopus vulgaris* were produced for the first time in large quantitites at the Instituto Español de Oceanografía (IEO) in Vigo, Spain, in 2018. This new

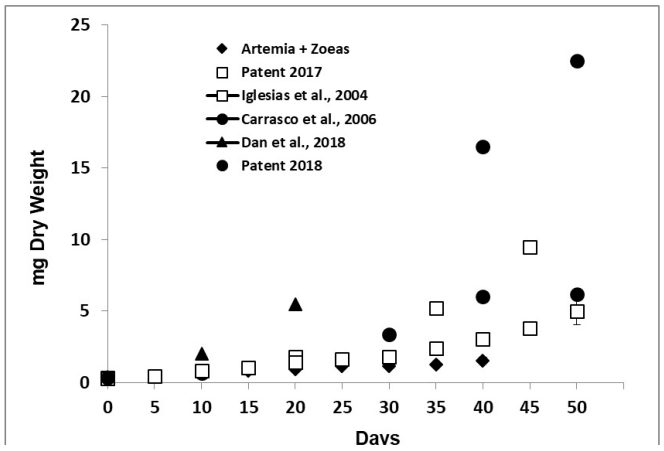


Fig. 1. Growth performance of Octopus vulgaris early stages cultured under a new culture protocol under patent at IEO compared to previous studies.

protocol comprises zootechnical and nutritional changes and has allowed IEO to obtain very high survival rates at the beginning of octopus paralarvae settlement, which were 65% higher than survival rates in previous experiments. The culture protocol allowed IEO to achieve the beginning of settlement at 33 and 38 days old. Previous studies of Iglesias et al. (2004) reported settlement at 50 days old and Carrasco et al. (2006) reported at 60 days old. Growth obtained with this new culture protocol was also considerably higher compared to other studies (Fig. 1).

The new IEO's culture protocol is under patent process (Patent 201731369). The patent owner is Pescanova, and due to confidentiality issues, no exact results can be published or released.

References

Carrasco JF, Arronte JC, Rodríguez C. (2006). Paralarval rearing of the common octopus, Octopus vulgaris (Cuvier). Aquaculture Research 37: 1601-1605.

Iglesias J, Otero JJ, Moxica C, Fuentes L, Sánchez FJ. (2004). The completed life cycle of the octopus (Octopus vulgaris, Cuvier) under culture conditions: paralarval rearing using Artemia and Zoeae, and first data on juvenile growth up to 8 months of age. Aquac. Int., 12: 481-487.

Iglesias J, Sanchez FJ, Bersano JGF, Carrasco JF, Dhont J, Fuentes L, Linares F, Munoz JL, Okumura S, Roo J, Van der Meeren T, Vidal EAG, Villanueva R. (2007). Rearing of Octopus vulgaris paralarvae: Present status, bottlenecks and trends. Aquaculture, 266: 1-15.

Iwasaki M, Harada R. (1985). Proximate and amino acid composition of the roe and muscle of selected marine species. J. Food Sci., 50: 1585: 1587.

Houlihan DF, McMillan DN, Agnisola C, Genoino IT, Foti L. (1990). Protein synthesis and growth in Octopus vulgaris. Mar. Biol., 106: 251-259.

Lee PG. (1994). Nutrition of cephalopods: fueling the system. Mar. Fresh. Behav. Physiol., 25: 35-51.

Navarro JC, Villanueva R. (2003). The fatty acid composition of Octopus vulgaris paralarvae reared with live and inert food: deviation from their natural fatty acid profile. Aquaculture, 219: 613–631.

Vaz-Pires P, Seixas P, Barbosa A. (2004). Aquaculture potential of the common octopus (Octopus vulgaris Cuvier, 1797): a review. Aquaculture, 238: 221-238.

Villanueva R, Riba J, Ruiz-Capillas C, Gonzalez AV, Baeta M. (2004). Amino acid composition of early stages of cephalopods and effect of amino acid dietary treatments on Octopus vulgaris paralarvae. Aquaculture, 242: 455-478.

Villanueva R & Norman MD. (2008). Biology of the planktonic stages of benthic octopuses. Oceanogr. Mar. Biol. Ann. Rev., 46: 105–202

Pedro Domingues, OPIs Researcher
Instituto Español de Oceanografía, Spain
E: pedro.domingues@ieo.es

Patagonian octopus reached F2 generation

By Mercedes Berrueta and Julián Desiderio, INIDEP

In recent years, there has been an increasing interest in the consumption and culture of several cephalopod species. Currently in America, different octopus species such as *Octopus maya, O. mimus, O. bimaculoides* and *Enteroctopus megalocyathus* are grown at different stages.

Patagonian octopus peculiarity

The Patagonian *pulpito* (*Octopus tehuelchus*) is one of the most important artisanal fisheries in Argentina. The adult Patagonian octopus weighs 150 g. This species, as other octopuses, presents parental care provided by the female during all embryonic development. The eggs are usually placed inside a snail shell or on artificial shelters. An early hatching juvenile weighs 0.14 g and is 5.6 mm long. This species is an interesting candidate for aquaculture due to its direct development of hatching a juvenile with similar adult features. This peculiarity, that lets them skip the paralavae stage, avoids the culture problems that other octopus of commercial interest has as *Octopus vulgaris*.

Closing the breeding cycle

Octopus tehuelchus juvenile and adult conditioning started at the Mariculture Experimental Station (EEM) of INIDEP in 2016. The objective was to determine the culture parameters in controlled conditions in a recirculating aquaculture system (RAS). Wild females that placed their eggs inside snail shells were collected and embryonic development concluded at the EEM.

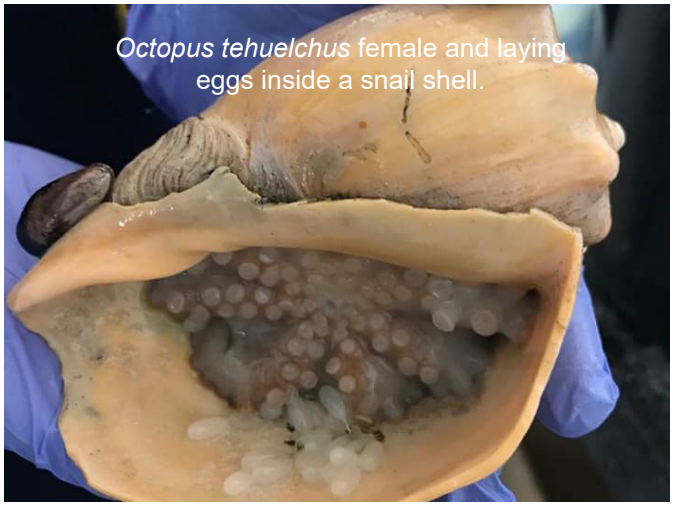
Juveniles born in captivity were kept in a system specially assembled to meet the needs of these invertebrates. Octopus were fed with live and artificial feed, adapting its composition to the different live stages needs. Once they reach the adult stage, sexing was performed with an ultrasound technique that reduces manipulation stress. Octopuses were distributed in a broodstock rearing system and, after 15 months, the first female born in captivity laid her eggs.

Currently, the first F2 generation juveniles are hatching with an average weight of 0.2 g and it has enabled the Experimental Station of Mariculture of INIDEP to close this species breeding cycle for the first time. In future experiments, replacing live feed with inert feed will be tested to see if it improves the juvenile culture stage on a larger scale. In Argentina, there is still no local production of commercial feed for marine species, which hinders the development of mariculture in general.

More information

Mercedes Berrueta, Researcher
Julián Desiderio, Technician
Instituto Nacional de Investigación y desarrollo pesquero (INIDEP), Argentina
E: mberrueta@inidep.edu.ar

Early hatching juvenile of Patagonian octopus.



Octopus tehuelchus female and laying eggs inside a snail shell.

Update on nutritional requirements of pike perch larvae and fry

By Ivar Lund, Najlae El Kertaoui, Covadonga Rodríguez, José A. Pérez, María S. Izquierdo, David Domínguez, Patrick Kestemont, DIVERSIFY project

Pike perch (Sander lucioperca) is a freshwater species with high commercial interest in aquaculture and increasing production in recirculation systems. This species was one of five species identified with a great potential for the expansion of the EU aquaculture industry in the recently finished EU project, DIVERSIFY.

The main bottlenecks and challenges for its intensive larval culture are larval and juvenile cannibalism, the lack of nutritional requirements knowledge and poor larval quality (deformities). Contrary to other freshwater species, pike perch larvae are very sensitive to low levels of dietary essential long-chain polyunsaturated fatty acids (LC-PUFA) causing lower growth, high mortality rates and deformities. There is no specific starter feed for this species, so pike perch are fed on diets that were developed for other marine species.

A series of trials were conducted in the framework of the DIVERSIFY project to elucidate larval and post larval nutritional requirements in phospholipids, fatty acids, vitamins and minerals to improve the quality of hatchery produced fry. Some results are briefly reported here. Larval trials were conducted at Technical University of Denmark, DTU, Institute of Aquatic Sciences, DTU Aqua or at University of Namur, Belgium.

LC-PUFAs and phospholipids

A complete substitution of marine oils with others that do not contain long-chain polyunsaturated fatty acids (LC-PUFAs), such as most vegetable seed oils, may compromise growth rate, stress resilience and immune-competence in larvae and fry. Moreover, most commercial oils used in fish feeds are in triglyceride form, while fewer oils are in phospholipid form. Phospholipid dietary supplementation has also been demonstrated to improve fish larval performance.

Six diets with three phospholipid levels (3.7%, 8.0%, 14%) were tested on 15 dph pike perch larvae for 25 days. Three of these diets had increasing levels of n-3 LC-PUFAs (EPA and DHA), which were supplemented in triglyceride form (Table 1).

Diet ingredients (%)	PL1	PL2	PL3	PL1H1	PL2H2	PL3H3
MicroNorse fishmeal	45	45	45	45	45	45
CPSP 90	7	7	7	7	7	7
Squid meal	13	13	13	13	13	13
Fish gelatin	1	1	1	1	1	1
Wheat gluten	4.4	4.4	4.4	4.4	4.4	4.4
Wheat meal	6.1	5.9	5.6	6.1	5.9	5.6
Algatrium DHA70	0.0	0.0	0.0	0.55	2.0	3.4
Olive oil	18.9	12.1	3.4	18.35	10.1	0.0
Vitamin & mineral premix PV01	1.0	1.0	1.0	1.0	1.0	1.0
Soybean lecithin powder	3.0	10.0	19.0	3.0	10.0	19.0
Analysed composition (% w.w.)						
Crude protein	54.1	54.7	55.6	54.1	55.8	55.3
Crude lipid	26.8	25.9	24.6	26.6	25.6	24.8
NFE + fibre (substracted)	3.0	3.0	2.8	2.8	3.1	3.2
Dry matter (DM)	93.0	93.0	93.1	93.6	92.8	93.5
Ash	9.1	9.4	10.0	9.0	9.3	10.2
Total phospholipids(TPL)	3.7	8.2	14.4	3.7	8.3	14.5
EPA (% d.w. TFA)	0.16	0.10	0.18	0.30	0.17	0.17
DHA (% d.w. TFA)	0.39	0.23	0.17	0.98	0.82	1.00

Table 1. Ingredient compositions and analysis of 6 experimental diets with different PL and EFA levels.

Results showed that a dietary content of at least 8% phospholipids and 1.2 % EFA, provided as DHA and EPA, had significant positive effects on larval growth, survival rates and deformities (Fig.1). LC-PUFAs diet supplement had an additive positive influence. Cranial and branchiostegal deformities (curved bones below the operculum supporting the gill membranes) rates were reduced as dietary phospholipid inclusion increased, while LC-PUFA supplementation seemed to have a small positive non-significant effect.

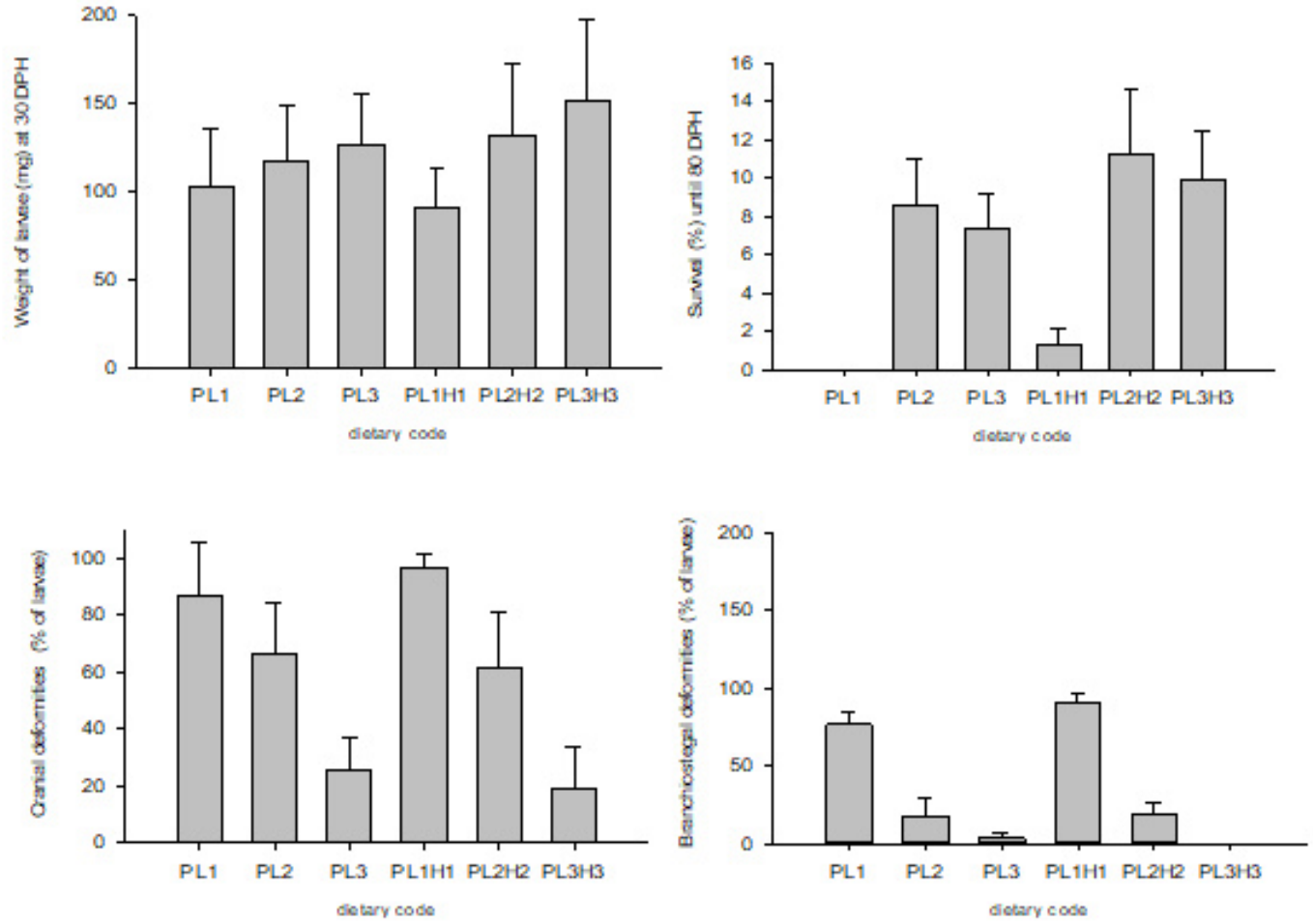


Fig. 1. Ingredient compositions of the linseed and sunflower oil experimental emulsions.

High dietary levels (8%) of marine phospholipids (which contains LC-PUFAs) were tested in other trials. This caused severe larval buoyancy with a subsequent high mortality. Therefore, the effects of marine phospholipids need further study.

Another trial was performed with the same six diets on 15 dph larvae until 80 dph. Juveniles fed on the lowest level of phospholipids diet, with or without LC-PUFAs, showed almost 100% mortality (Fig.1). Juveniles fed on the other 4 diets were tested on their reactive behavior to mechanic-sensor stress stimulus, but no differences were observed in contrast to the effects observed in juveniles reared on diets without phospholipids and LC-PUFAs during early larval stages. These results indicate a function of relatively high levels of phospholipids on neuromuscular pathways involved in escape responses.

These results suggest that a successful factor in rearing of pike perch larvae is related to the dietary oil type (triglyceride/phospholipid) and content of LC- PUFAs. However, it should be taken into account that in these trials, olive oil was the main oil source. This oil, which is a triglyceride, is also composed by mainly monounsaturated fatty acids with no n-3 LC- PUFAs and no precursors of these (18:3 n-3).

Vegetable oils to LC-PUFAs

Based on the previous results, trials were performed to test the ability of first feeding pike perch larvae to desaturate and elongate LC-PUFAs precursors (18:3n-3, 18:2n-6). Linseed oil, sunflower oil and radioactive labelled fatty acids were used (Table 2). Rearing salinity was included as a factor for its known effects on modulation and expression of Δ6 desaturase activity involved in changing fatty acid composition in other fishes.

Diet Ingredients (%)	SFO	LO
Linseed oil	0	68
Sunflower oil	85	0
Olive oil	4	21
Soy lecithin	7	7
Vitamin Premix	4	4

Table 2. Weight and deformities of pike perch larvae at 30 dph and survival at 80 dph.

Results revealed that salinity has no effect on growth rate, but anomalies increased at higher salinities because salinity is involved in some regulatory endocrine processes. Larval fatty acids tissue profiles suggested a low desaturation and elongation ability. The results underline the critical role of LC-PUFAs in pike perch larval diets.

Effect of dietary minerals

One of the most important mineral interaction in fish is calcium (Ca) and phosphorus (P). The pike perch farming industry relies on the use of commercial feeds developed for marine fish species and Ca/P ratio that is probably not optimal. Six diets with three Ca/P ratios (0.3, 0.6 and 1.2) and different Ca and P concentrations were tested (Table 3) on 21 dph pike perch larvae during two weeks.

	Diet 1	**Diet 2**	**Diet 3**	**Diet 4**	**Diet 5**	**Diet 6**
Crude protein, %	51.16	51.15	51.14	51.14	51.16	51.17
Crude fat, %	18.46	18.46	18.46	18.46	18.46	18.46
Fiber, %	0.16	0.16	0.16	0.16	0.16	0.16
Starch, %	9.97	8.02	4.20	4.21	11.48	15.17
Ash, %	9.04	10.96	14.72	12.95	8.46	6.18
Total P, %	2.68	2.68	2.68	3.97	2.01	1.01
Ca, %	0.80	1.61	3.21	1.20	1.20	1.20
Ca/P	0.30	0.60	1.20	0.30	0.60	1.19

Table 3. Composition of diets with calcium and phosphorus inclusion.

Larval growth and survival rate were significantly affected by the P dietary content (Fig. 2), suggesting the importance of a balanced Ca/P ratio and P level in pike perch larvae diet. In addition, it appears that total P content should be considered in determining the optimal Ca/P level.

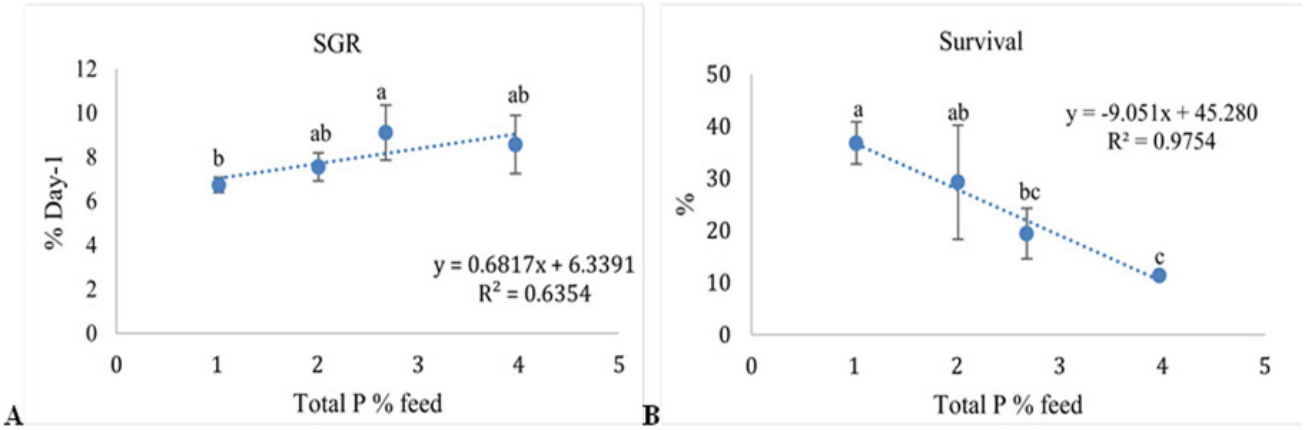


Fig. 2. Phosphorus effect on larval growth (A) and survival rate (B).

Future commercial feed

An extruded experimental diet and a commercial Japanese diet were tested in a hatchery on 20 dph pike perch larvae for 30 days. Results showed a significantly higher growth of the experimental diet at the end of the experiment (Fig. 3). These results will be further validated and confirmed in upcoming trials.

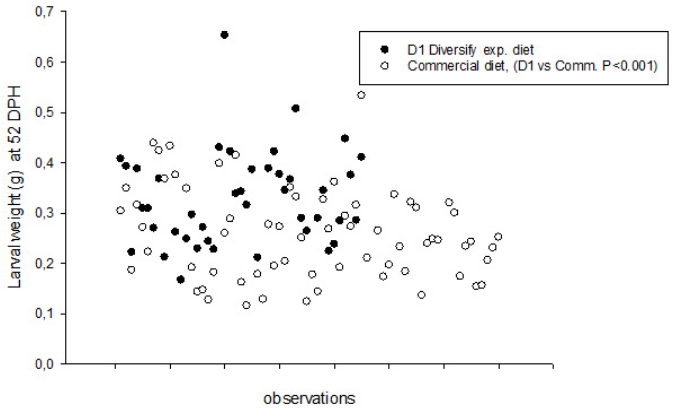


Fig. 3. Individual larval weight (g) at 52 dph fed on Diversify and commercial diet.

This work was supported under the framework of the European Union Seventh Framework Program project DIVERSIFY (KBBE-2013-07 single stage, GA 603121). Further information at Lund et al., 2018, Lund et al., 2019*.*
**References available upon request*

Ivar Lund, Senior Scientist
Technical University of Denmark
Hirtshals, Denmark
E: il@aqua.dtu.dk

Copepods, natural feed for marine fish and shrimp becoming the new industry standard

By Björn Ronge, CFEED

CFEED, the largest and the only industrial producer of marine copepods, has for half a decade performed studies on more than 20 different marine species around the world. The copepods (Acartia tonsa) are produced in a full cycle and closed aquaculture system using a state-of-the-art water treatment system, which results in a fully pathology free and biosafe product.

Copepods are the natural prey for most marine species in the earlier stages. They inhabit tropical to arctic regions and are the most abundant organisms in the ocean. Therefore, marine fish, shrimp and other organisms are perfectly adapted and, in many cases, dependent on the nutritional composition of copepods. For many years, feed producers have focused on the nutritional profile of copepods trying to simulate it in their diets and live feed enrichments. However, the complex composition of copepods is very hard to imitate and the fact that copepods contain active enzymes helping them to be easily digestible and essential micromolecules to the sensitive development of fish larvae, such as taurine, has made artificial diets unsuccessful.

Copepod trials

CFEED has emerged from the start-up community of the research institute SINTEF Ocean and NTNU in Trondheim, Norway and has a purely scientific market approach. The CFEED copepods were tested in different key species, especially those difficult to produce with traditional live feeds, in research facilities and later in industrial hatcheries to optimize the feeding regimes. This has slowly led to a change in the farm procedures of these species and copepods are becoming a new industry standard.

One example of these trials was performed at KINDAI, the largest Japanese blue fin tuna (*Thunnus orientalis*) and Japanese yellowtail (*Seriola quinqueradiata*) producer. KINDAI is now in their third year using copepods as early live feed for their larvae. CFEED has helped them to reduce high mortality rates traditionally experienced in the first two weeks and to improve growth and quality (Fig. 1).

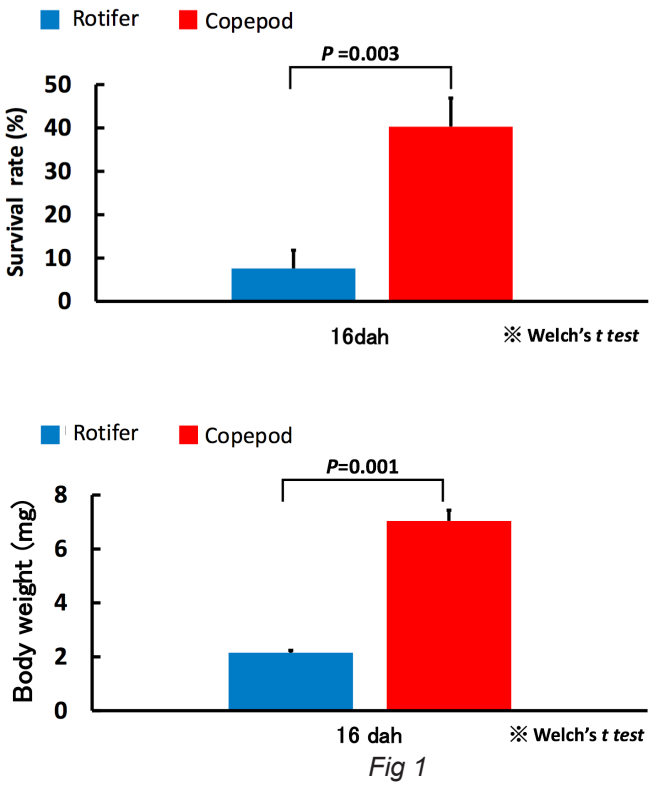


Fig. 1. Differences in survival rate and body weight at 16 dph. Source: Aquaculture Research Institute, Kindai University, Japan 2018.

Fig 1

Long term trials performed in other species showed significant increases in juvenile growth and survival rates which were maintained throughout the production cycle. One of these trials was performed with cod at the NOFIMA in Tromsø, Norway. Cod which fed on copepods showed 25% higher weight at harvest (Fig. 2).

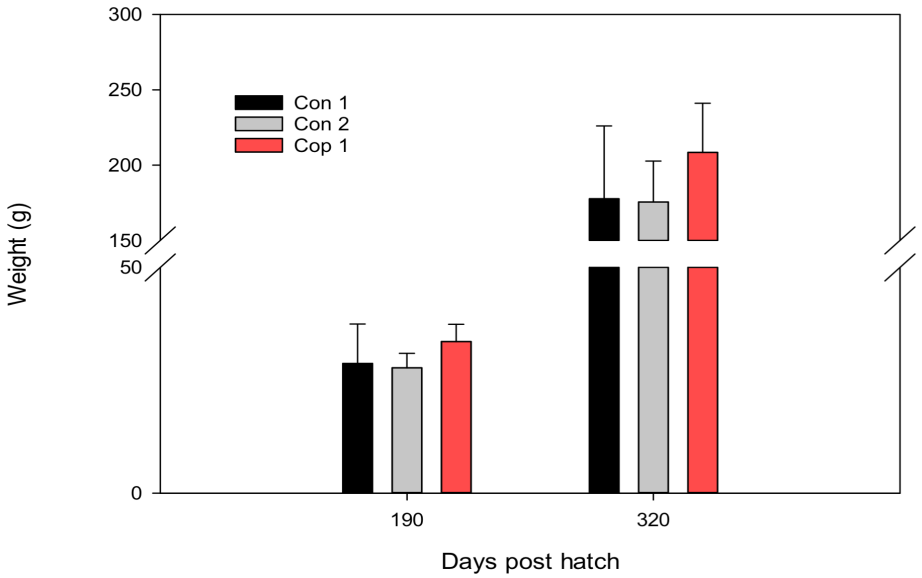


Fig. 2. Differences in weight of cod fed on copepod (Cop 1) and control groups fed on enriched rotifer and Artemia (Con 1 and Con 2) at 320 dph. Source: NOFIMA, Tromsø, Norway, 2017.

The Norwegian and Scottish salmon industry is increasing their production of salmon lice cleaner fish, ballan wrasse (*Labrus bergylta*). This species, which has no stomach, needs easily digestible feed and, therefore, it is a key species for copepods, as their active enzymes are self-digested and fully consumed. CFEED is closely involved in most ballan wrasse projects and has performed a study comparing the industry standard feeds with copepods at the Gesellschaft für Marine Aquakultur in Büsum, Germany (Fig. 3). Ballan wrasse larvae that fed on copepods showed advanced gut development, gut fullness and higher pigmentation and survival rates.

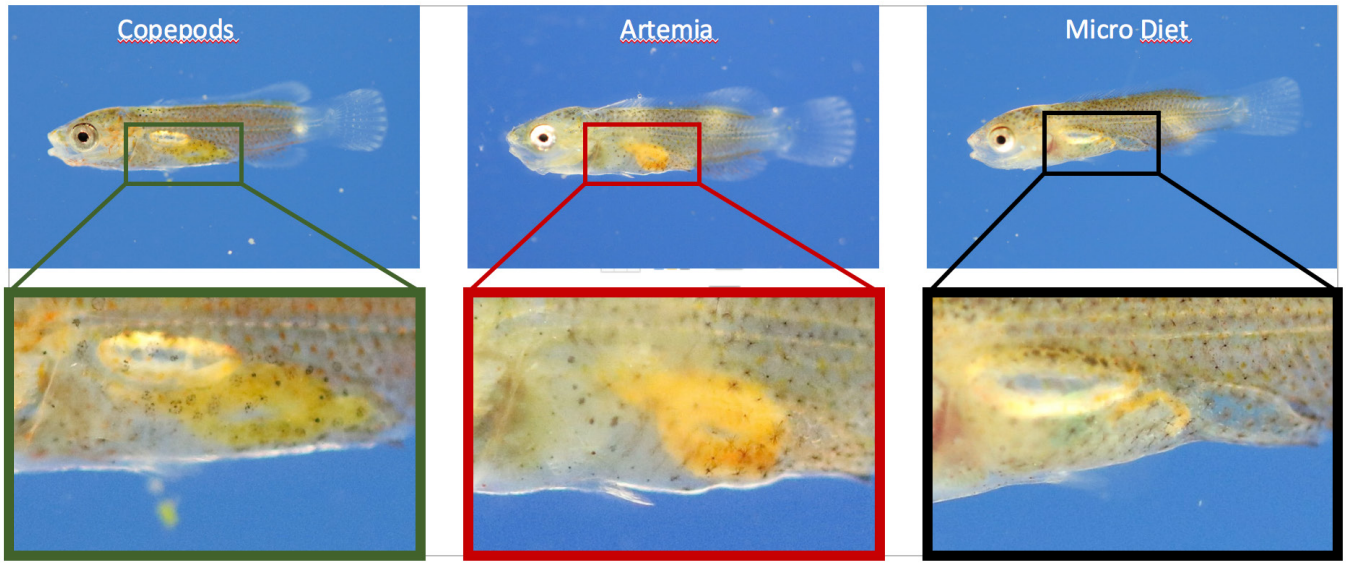


Fig. 3. Randomly selected ballan wrasse larvae fed with copepods (left), copepods followed by Artemia (middle) and microdiets (right) at 32dph. Source: Gesellschaft für Marine Aquakultur in Büsum, Germany, 2018.

Another market segment requesting copepods is European land-based shrimp producers, who are highly dependent on high success in larval rearing due to the lack of available larvae in Europe. CFEED has four clients using copepods as early starter feed for white leg shrimp (*Litopenaeus vannamei*) who are testing the effects in larval survival and growth.

CFEED copepods are being used by public aquariums all over Europe for ornamental fish, jelly fish and exotic species for conservation projects. Since 2018, it has also been possible to buy CFEED copepods in small volumes for private aquarium use through various distributors.

CFEED is also developing optimized feeding regimes with partner feed producers to further strengthen the larval production of their clients. The combination of copepods with high quality later stage larval feed improves fish quality and growth and lowers the total production cost for the hatcheries.

CFEED future focus

In the future, CFEED wants to focus on the large European marine fish market with species such as sea bream, sea bass, turbot and amberjack. Trials with copepods have been performed on all these species with very positive results, but the protocols need to be further improved to make copepods a cost-effective feeding on these relatively low-value fish species. CFEED is also aiming at the international shrimp market to promote growth and disease resistance improving feeding doses. These trials will be conducted in the USA and Thailand by major shrimp breeders.

CFEED opened its EU headquarter and R&D facility in Büsum, Germany in March 2019. A tight collaboration with Germany's most prominent microalgae producer, BlueBioTech, became in a partnership in research and supply of copepods and algae from a European central region.

Copepods are a clear alternative to the traditional live feed. Because of demand increases and more knowledge becoming available, CFEED is currently looking for strategic investors to expand their copepod factory to feed an even larger portion of the blue future.

Björn Ronge
Marketing Director, CFEED
E: bjorn@cfeed.no

Current status of *Seriola dumerili* culture at GIA/ ECOAQUA-ULPGC, Spain

By Javier Roo, GIA/IU-ECOAQUA

Greater amberjack broodstock sampling

The Aquaculture Group (GIA/IU-ECOAQUA) of the University of Las Palmas de Gran Canaria (ULPGC), in Gran Canaria Island, Spain has been working on greater amberjack (*Seriola dumerili*) culture since 2006 with important contributions in different R&D programs at regional, national and international levels. GIA is currently coordinating the SERIOLA program in the framework of the Spanish national plan for aquaculture diversification and is co-funded by the Ministry of Agriculture, Fisheries, and Food (MAPAMA) and the European Maritime and Fisheries Fund 2014-2020 (EMFF).

The SERIOLA program, in addition to the R&D GIA's actions, is conducting validation trials and pilot scale tests in collaboration with commercial companies. This article summarizes the important milestones reached by GIA to fine-tune the broodstock management and juvenile production protocols to make the leap from R&D dimension to pilot scale production.

Broodstock

GIA's broodstock was established with nine wild subadults (1.66 kg) captured on the south coast of Gran Canaria in May 2006, more than 60 big broodstock (12 kg) including F1 and F2 generation and 100 pre-broodstock fish. Trials were performed to improve broodstock management and spawning control by optimizing hormonal induction protocols (Fernández-Palacios *et al.,* 2015; Sarih *et al.,* 2018). As a result of these studies, three different spawning protocols were established since 2015: natural broodstock in open system (40m3), hormonal induced broodstock in open system (40m3) and hormonal induced broodstock in RAS system (30m3).

In addition, different nutritional studies were also performed to evaluate the effect of n-3 HUFA and the supplementation of specific aminoacids, such as histidine and taurine, in broodstock diets (Fig. 1) (Sarih *et al.,* 2019). Due to these studies, fresh food was completely removed from broodstock feeding procedures at GIA.

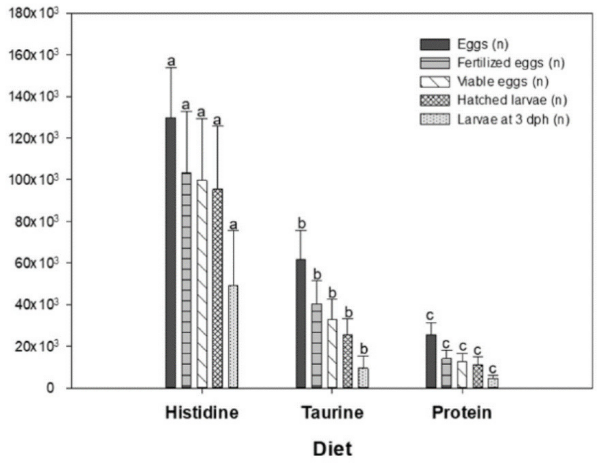


Fig. 1. Production rates of greater amberjack broodstock fed on different experimental diets (Modified from Sarih et al., 2019)

Larval and juvenile production

GIA/ECOAQUA has performed larval trials with two lines of research. On the one hand, the center aims to improve larval nutrition, mainly focused on the definition of nutritional requirements and development of specific enrichments and micro-diets (Roo *et al.,* 2019). On the other hand, the objective is to optimize and upscale larval rearing zootechnics (Roo *et al.,* 2019 submitted).

35 dph greater amberjack larvae

More than 50,000 juveniles were produced and shared with the R&D and commercial partners of the program. They were produced thanks to new protocols and knowledge as a result of tests conducted at the center.

GIA/IU_ECOAQUA identified the optimum level of omega-3 polyunsaturated fatty acids (n-3 PUFA) (Fig. 2) and a new functional diet with phytobiotics was developed and tested on an experimental scale. This diet will be produced in collaboration with Skretting Spain and will be tested to evaluate growth performance and parasite resistance on both RAS and offshore cages on a commercial scale.

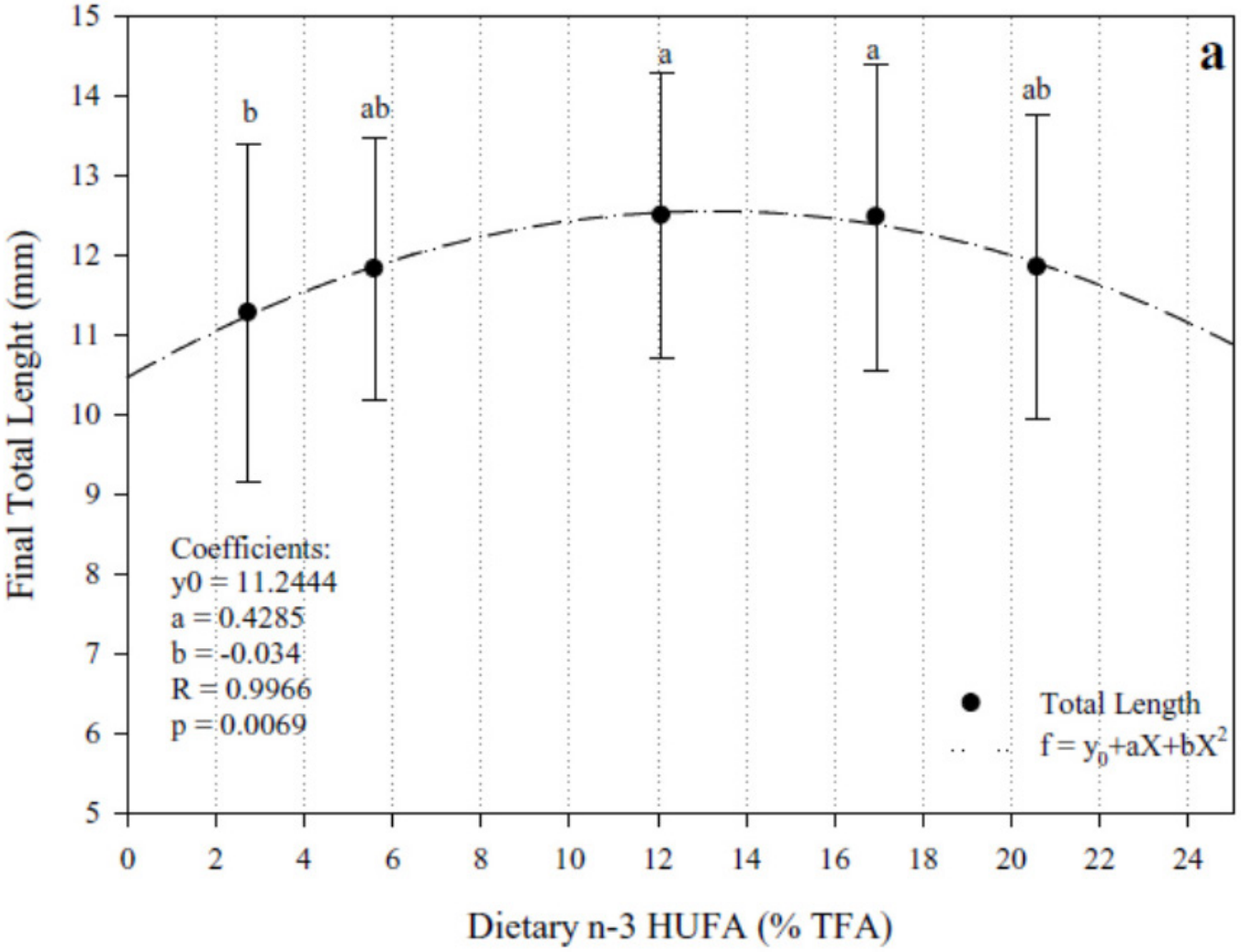


Fig. 2. Relationship between total length (mm) and dietary (Artemia) n-3 HUFA content (%TFA) in greater amberjack larvae at 35 dph (mean + S.D., n = 3). Data is fitted to a quadratic regression analysis (f = y0 + ax + bx2). (Modified from Roo et al., 2019).

Amberjack juveniles were also successfully transported by truck for more than 72 hours to the Institute for Aquaculture of the University of Santiago de Compostela and the Aquaculture Cluster in Galicia to carry out pathological tests and validation in recirculation aquaculture systems (RAS), respectively. Another batch of amberjack juveniles was sent to IFAPA El Toruño in Andalucía to perform different on-growing studies about the effect of salinity and pH in RAS systems.

Fig. 3. Greater amberjack juvenile infected with external parasite (Neobenedenia seriolae, arrows) and healthy juvenile

Offshore validation tests are being performed in two different oceanic scenarios to identify the effect on the biological performance of the species. One trial is performed in the Mediterranean sea with 13-30ºC annual seawater temperature variation in collaboration with CTAQUA Aquaculture Technology Centre in Andalucía and the company Piscifactoría de Albaladejo SL, in San Pedro del Pinatar (Murcia region). The other is conducted in the Atlantic Ocean (Canary Islands) with 18-24ºC annual seawater variation in collaboration with the Association of Spanish Aquaculture Producers (APROMAR) and the commercial company Acuipalma SL, in Tazacorte, on the La Palma island.

Final results of these studies will be presented at a specific workshop organized by the SERIOLA program by the end 2019.

References

Fernández-Palacios H, Schuchardt H, Roo J, Hernández-Cruz C, Izquierdo M. (2015). Multiple GnRHa injections to induce successful spawning on wild caught greater amberjack (Seriola dumerili) matured in captivity. Aquac. Res. 46, 1748–1759.

Roo J, Hernández-Cruz CM, Mesa-Rodríguez A, Fernández-Palacios H, Izquierdo MS. (2019). Effect of increasing n-3 HUFA content in enriched Artemia on growth, survival rate and skeleton anomalies occurrence of greater amberjack Seriola dumerili larvae. Aquaculture 500: 651-659.

Roo J, Djellata A, Sarih S, Hernández-Cruz CM. (2019). Weaning protocol optimization for greater amberjack larvae (Seriola dumerili). Under review CAN 2019.

Sarih S, Djellata A, La Barbera A et al. (2018) High-quality spontaneous spawning in greater amberjack (Seriola dumerili, Risso 1810) and its comparison with GnRHa implants or injections. Aquac Res. 2018;00:1–9.

Javier Roo, Senior Scientist
IU-ECOAQUA, Spain
E: froofil@gobiernodecanarias.org

Column

Developments in Aquaculture

Aquaculture Ghent University

By Prof. Dr. ir. Peter Bossier, Director of the Laboratory of Aquaculture & Artemia Reference Center, and Chairman of Aquaculture Ghent University.

Microbes rule the world - and your larval tank too

The scientific and public interest in the impact of microbes in our daily life is increasing. Although catchy, it might be stated that microbes are “invisible” rulers of our life.

So it comes as no surprise that scientific evidence for strong microbial interference in larviculture is surging. It is of course clear that proper nutrition is paramount for the development of larvae and unravelling nutritional requirement at larval and juvenile stages is an ongoing process.

Yet, under laboratory and industrial conditions, one can see a large variability of especially survival and robustness in larvae. This compromises the industrial process, because as in any industrial process consistency in output is very important. It can be demonstrated that this variability can be reduced by using antimicrobials, indicating that there is a large microbial contribution to the lack of reproducibility in larviculture.

For microbes to be important in host microbial interactions, one would assume that their abundance is important, which touches upon the idea of how much microbial biomass is actually produced while larvae are being cultured. For this apparently very basic question, it is surprisingly hard to find answers in the scientific literature. Partly based on the review paper published recently in Frontiers in Microbiology (“Managing the Microbial Community of Marine Fish Larvae: A Holistic Perspective for Larviculture”), allow me to make an educated guess: skipping the details, it can be calculated that for every 30mg larvae produced per litre in the first month, about 6mg microbial biomass is produced, which sounds substantial. This brings us to the next question: are they all bad bugs? The answer is simply: it depends. Most of the microbes are what we call mutualistic and are just around because there happens to be food in the tank. Some of the microbes are opportunistic pathogens, and maybe even fewer are really pathogenic. So, it comes down to the idea that we need to manage the dynamic microbial community in the tank by trying to favour mutualistic or even favourable microbes. Are there any tools that can be used to accomplish this?

Although there is a substantial lack of knowledge on “who is out there”, it is becoming apparent that management is possible. Among others (I hope to dwell on them in another editorial), there is one important parameter to be considered at every time point in the production process: the ratio of organic carbon input per unit of microbial biomass present in the system. If that ratio is kept low, evidence is mounting that opportunistic pathogens can be kept at bay.

So, in order to manage the microbial community either the input of organic carbon needs to be kept low or the standing microbial biomass need to be kept high or both. Input of organic carbon can be managed by, for instance, increasing the feeding frequency of live food or micro-diets and hence reducing peaks in organic input. Care should be taken with the quality of algal paste as they can leak, releasing carbon for opportunistic pathogens. Live food, such as Artemia, should never be frozen (as apparently is still happening) because they are leaking substances which only favor unwanted microbes. Upon hatching, *Artemia* is better stored cold, not only for nutritional reasons, but also as part of an overall microbial management strategy. On the other hand, the microbial biomass in the system can be kept high. This can be done in the larval tank or outside the larval tank. For the latter, recirculation systems are an obvious solution, where care needs to be taken not to overload the system. This can be done by installing e.g. protein skimmers, or by choosing the correct ratio between larval tank size and recirculation system size (or both). Although less well documented, offering surface for microbes to grow on in the tank (such as clay minerals) might be beneficial from a microbiological perspective (but care should be taken as not all larval species might be comfortable with the increased turbidity). Clay can also be responsible for aggregation of organic matter facilitating its precipitation in the tank where it can be removed. Finally, the green water technique might be used. Microalgae have many beneficial effects, but a possible forgotten feature is their capacity to grow mixotrophically removing carbon from the system.

The examples are by no means exhaustive and some are even speculative. They merely highlight that there are opportunities to manage microbial community composition to the benefit of the larvae, so as to move away from the idea that we have “to beat microbes”.

RAS feed must be consistent: enter NIR

By Ørjan Breivik, Skretting Aquaculture Research Centre

Recirculating aquaculture systems (RAS) require consistent quality to minimize any negative impact on the systems. As raw material flexibility increases, there is a parallel increase on the demand for precise raw material information for feed formulators to ensure that the quality is optimized for each and every batch. Near-infrared reflectance (NIR) spectroscopy can be used to ensure customers receive consistent high quality feeds, no matter which raw materials are used.

What is NIR?

NIR spectroscopy uses absorption of infrared radiation to provide information about the biological sample (e.g., feed ingredients, feed, fish flesh). In essence, the components of the sample will absorb energy within a set of infrared wavelengths between 780 and 2500 nm. The amount of energy being absorbed is measured by the NIR instrument and transformed using chemometrics to estimate the presence and the concentration of each component in the sample.

Every raw material is unique

All raw materials have their own unique nutritional profile (Fig. 1) and the exact profile of any raw material will vary from batch to batch. The nutrient profile and digestibility can be influenced by factors such as origin, processing conditions and storage time. Although tables are available with typical nutritional values of most raw materials, these are only approximations and lead to less precise formulation and that is possible with an accurate analysis of every batch. Besides gross nutrient levels, using NIR we are able to measure the nutrient digestibility from each and every batch of feed ingredients used (Fig. 2).

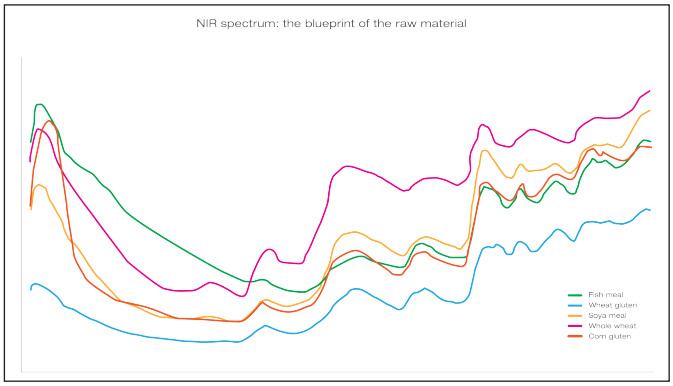


Fig. 1. The NIR spectrum provides a blueprint of any raw material

Precision nutrition in RAS feed

For RAS systems, precision and consistency in feed quality is crucial. Feeds for RAS should have the exact level of nutrient that fish need for growth, not less, not more. Less nutrient in feed reduces fish growth, whereas an excess of nutrient in feeds is unused by fish and goes into water, which gives extra burden on the system to remove. NIR ensures that we formulate and deliver RAS feed with precise level of digestible nutrients, like protein, and energy to fulfill the nutritional needs of fish. Therefore, we attain the best FCR and fish growth from each batch of feed.

Specific analytical results for every raw material and feed are centrally stored in Skretting. Instruments are installed at each feed plant to ensure that the results fit with the specification. Skretting Aquaculture Research Centre (ARC) is responsible of the calibration of the NIR instruments in Skretting for raw materials and feeds in-line with ISO guidelines, and to monitor that the calibrations are applicable for all instruments in the global Skretting NIR network. This ensures NIR instruments, regardless of location, are aligned with regards to produce consistent nutritional content for the samples being analyzed. However, it's not only nutrition.

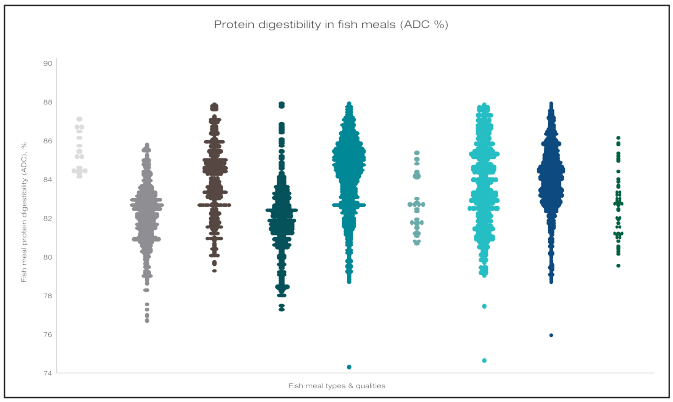


Fig. 2. Variable protein digestibility in fish meals [apparent digestibility coefficient (ADC), %]

Continuing progress

New technologies allow complete analyses to be performed automatically in feed factories, mimicking the manual analytical work done by operators today. Using in-line NIR technologies provides real-time response to factory operators in the performance of the feed ingredients and feed. This allows the operators to produce even more consistently, as they are able to compensate for variations in raw materials and process.

NIR for fish quality

NIR can be applied to wet samples like fish flesh to measure components of interest. Using NIR, we are able to support our customers to measure the level of total fat and omega-3 fatty acids (EPA and DHA) in their fish during production, which allows the selection of different feed strategies to achieve specific target levels of omega-3 fatty acids in fish at time of harvest. This enables value addition to our customers to obtain premium product and price.

What does this mean for farmers using RAS?

Using well-established NIR technology in Skretting factories, farmers using RAS can ensure a feed:

- That contains a precise nutrient composition for the fish ensuring the highest nutrient digestibility, the best FCR and growth.
- With consistent quality ensuring predictable feed performance.
- That reduces the amount of nutrient excess ending up in the water.
- That enables RAS farmers to produce high quality fish and ensure their fish product quality.

**References available upon request*

Ørjan Breivik, NIR Team Leader
Skretting Aquaculture Research Centre
E: oerjan.breivik@skretting.com

New Products

New hatchery feeding system for live feed

Fish Farm Feeder's new feeding system for live feed

Low reproducibility in terms of survival, growth and quality is one of the main problems that hatcheries have to face. It is assumed that these problems are caused by nutritional and microbiological factors. Moreover, fish larvae have high growth rates which means that live feed should be continuously available. Therefore, it is necessary to have a continuous dosage of high-quality live feed.

Manual live feed dosage is the most common method used in hatcheries. As live feed is added several times a day, variations of its availability are expected. These variations reduce live feed nutritional quality and environmental conditions.

A new technology

Fish Farm Feeder, which supplies inland feeding systems from hatcheries to grow-out, launched a central feeding system for live feed, a new technology to manage centrally and automatically live feed in fish hatcheries. It provides a solution to automatically deliver microalgae and live prey, rotifer and Artemia, to larval culture tanks. Live feed is stored cold and controlled by a production management software that receives input from environmental control systems (dissolved oxygen, temperature, pH, turbidity, etc). It allows a high precision feed dosing that provides a constant availability of high-quality live feed to the larvae.

Improving outputs

Continuous live feed supply improves marine finfish hatchery outputs. A 5-15% increase in larval survival and a 1-5% reduction in larval deformities are achieved due to reduction of live feed retention time and lower loss of enrichment quality in the larval tank. More precise dosages improve water quality with a reduction of pathological outbreaks up to 20%. It reduces operational costs up to 5% and increases labor productivity by reducing highly time-consuming tasks.

The central feeding system for live feed introduces a change in the current feeding practices in hatcheries that increases feed efficiency and growth rate, ensures quality, improves animal welfare and is a key contributor to business sustainability.

Miguel Arostegui, CEO
Fish Farm Feeder
E: miguel.arostegui@fishfarmfeeder.com

Product Focus

AlgaSpring Nannostar, redefining algae for aquaculture

By René M. Jongbloed, AlgaSpring

AlgaSpring facilities in Almere, The Netherlands

For many marine fish species, algae culture remains an integral part of the production process. The beneficial effects of algae on survival, stress resistance and general performance have been demonstrated in hatcheries time and again. This is due not only to the inimitable nutritional features of the algae but also to the unique influence that marine algae have on the bacterial flora and other aspects of the rearing environment. Replication of the combined effects of these two factors is not possible through the use of artificial products.

The use of marine algae artificial alternatives sometimes creates more problems than it solves. For example, products with a nutritional profile based on ingredients such as fish oil can, and do, increase opportunistic bacterial load to dangerous levels. This, in turn, can cause problems in fish larvae that are sometimes obvious to any experienced hatchery manager through microscopic observation, but other times are not noticed at all and only show up in poor stock performance. This poor performance can be often attributed to other unrelated causes.

Outsourcing algae production

Algae production in marine fish hatcheries is a complex process that adds to the already complicated sequence of production processes. It is our responsibility as producers not only to improve and stabilize our production processes, but also to simplify them as much as we can. The obvious solution, therefore, is to outsource algae production. However, in the past this has been expensive and at times unreliable.

Marine algae species are not easy to produce on an industrial scale because they require excellent water conditions, a stable environment and incur high costs in energy and quality nutrients. Logistics have been difficult as shelf life has been low and variable. The objective of AlgaSpring has been to solve these issues in supplying a range of algae-based products that are cost-effective, biosafe, readily available, and that simplify and stabilize the production process for marine fish hatchery managers while improving productivity and quality at the same time.

Nannostar in rotifer

"Our products are successful because they work," explained René Jongbloed, Managing Director. "Rotifer density increases through the use of Nannostar. Compared with conventional dry diets, FCR can be doubled for every gram dry weight of diet (Fig. 1). This means that less biomass is fouling the water and basically feeding bacteria. Bacteria load is higher with other products as potentially pathogenic Vibrio on TCBS medium increases when less feed is being converted into rotifer biomass (Fig. 2)."

Another important factor is that although artificial products can give good results in most cases, it would be better if live feed diets could be tailored to specific species requirements. AlgaSpring's production facilities are flexible and can produce algae that fit the theoretical optimum needs of the species being cultured, working directly with customers to develop requested formulations and applications.

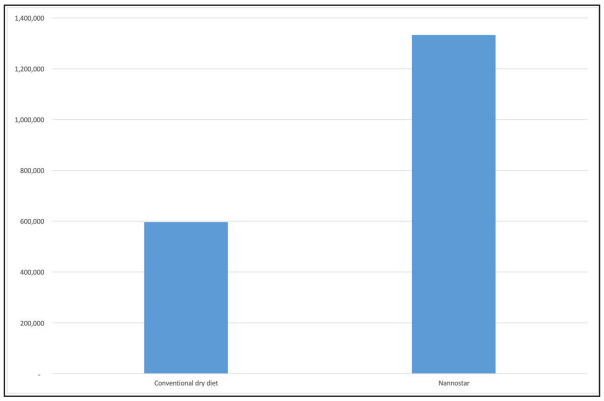


Fig. 1. Higher conversion rate per gram dry weight of rotifer fed on Nannostar compared with conventional dry diet.

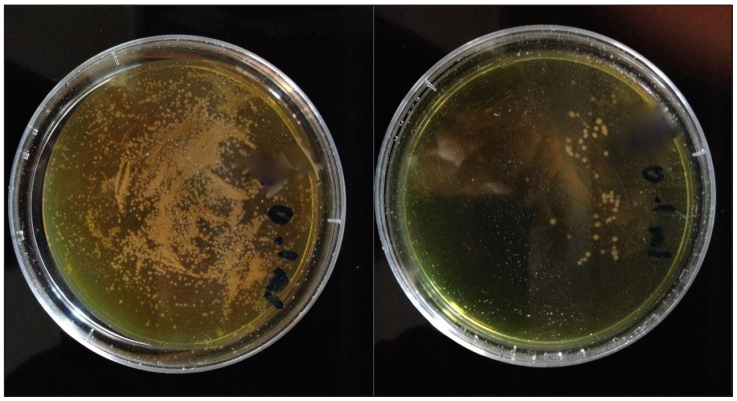


Fig. 2. Difference in potentially pathogenic and opportunistic Vibrio densities (TCSB) in rotifer fed on artificial dry diets (left) and Nannostar (right).

AlgaSpring uniqueness

AlgaSpring products have been designed from the hatchery production point of view by a team with a high level of expertise, not only in algae but also in hatchery production. The algae are unique. They are grown on an ancient 130,000 year old marine fossil water source and are GMP+ and ISO 22000 certified. The production process is also unique as the algae are grown in efficient large-area bioreactors. The nutritional profile fits the nutritional requirements of marine fish larvae on its fatty acids (EPA, DHA, etc) and lipids (phospholipids, triglycerides, etc.) profile. Even processing operations are unique. Pasteurization produces a biosafe product without rendering the product ineffective for use in marine larviculture, as is frequently the case. Many other similar products do not give the same results and this is especially clear in rotifer growth and larval fish performance due to the processing techniques employed.

The rotifer production with NannoStar algae is simplified, more stable and cleaner. Application in green water technique has the same advantages as many hatcheries have reported less pathological problems, better fish quality and more stable production. Through the extensive knowledge of problems and solutions of both marine algae and marine fish hatchery production, AlgaSpring is confident that they can extend this success throughout the marine aquaculture industry, providing much-needed support for marine fish hatchery managers.

René M. Jongbloed, AlgaSpring BV
The Netherlands
E: sales@algaspring.com

Product Focus

Cargill Aqua Nutrition sets sights on early rearing aquafeed leadership

With its two production facilities in the U.S. and Canada, Cargill Aqua Nutrition (CQN) now offers starter products for both freshwater and marine species, finfish and crustaceans, and in various forms to allow maximum flexibility to support early rearing needs.

EWOS Canada Ltd., a subsidiary of Cargill Ltd., has long offered three variants of crumble starter diets, EWOS Micro™, EWOS Natura™ and EWOS Nature™. While EWOS Micro™ is a premium diet for customers seeking the best all-around performance, EWOS Natura™ provides an alternative for customers who wish to balance performance goals with economic constraints. EWOS Natura™ is also documented to be the preferred nutritional solution for some Pacific salmon species including coho, chum and pink. EWOS Natura™ can also be used for non-salmon species such as bass, sturgeon and tilapia. The EWOS Nature™ range of micro-crumbles follows a nutritional profile similar to EWOS Micro™, but is formulated to be free of terrestrial animal proteins and oils, thereby, supporting customers adhering to certain certifications or targeting specific markets.

New products for AquaXcel™ line

Building upon the existing crumble range, CQN North America is introducing a new range of micro-extruded pellets. Using the formulations of EWOS Micro™ and EWOS Natura™ crumbles and following a significant investment in the Cargill Franklinton, Louisiana plant, CQN NA is launching EWOS Micro Xcel™ and EWOS Natura Xcel™.

EWOS Micro Xcel™ is a premium micropellet starter diet that is designed to deliver nutritional excellence and high performance while maintaining culture system hygiene. EWOS Micro Xcel™ offers supreme growth and low feed conversion efficiency for salmon species as well as sturgeon, greater amberjack, bass, walleye and barramundi.

EWOS Natura Xcel™ is a micropellet starter diet that supports optimized growth and efficiency. Formulated to meet nutritional requirements, EWOS Natura Xcel™ offers significant growth and performance potential and, like EWOS Micro Xcel™, it offers improved culture system hygiene.

Both micropellet ranges include EWOS Optifin™, an exclusive feed additive that delivers a supplemental source of nucleotides to support fish health and growth in the early life stages of production. All EWOS starter diets are made with sustainable raw materials of the highest quality to give first feeders and fry the best possible start, and to maximize survival and growth in the early culture period.

Micro-extrusion technology provides a high quality, uniform product that is low in feed fines, has improved water stability, offers exceptional tank and system cleanliness as well as significantly less clumping and ease of use in automatic feeding systems. EWOS Micro Xcel™ and EWOS Natura Xcel™ provide a consistent sink rate and are available in 0.3 mm, 0.6 mm, 0.8 mm and 1.2 mm micropellets. These sizes have been carefully selected to ensure the alignment not only with the growth profile of the intended fish species, but also with the production cycle procedures as movements, grading and vaccination. EWOS Micro Xcel™ and EWOS Natura Xcel™ are ideal aquafeed solutions for recirculating aquaculture systems (RAS) and flow-through systems.

The new lines of EWOS micro-extruded pellets complement the existing Franklinton-produced product, AquaXcel™. Cargill's AquaXcel™ is a long-serving product line designed with early nutrition in mind. Available in the same product sizes, 0.3 mm, 0.6 mm, 0.8 mm and 1.2 mm, AquaXcel™ benefits from the same advantages offered in EWOS Micro Xcel™ and EWOS Natura Xcel™, including pellet quality, consistency, tank cleanliness and superior nutritional performance. AquaXcel™ is another cross-functional product line and has a good track record in a variety of marine and freshwater fish and shrimp.

Liquid feed for larval shrimp

AquaXcel™ is further complemented by another Cargill's offerings, LiquaLife®, the world's first liquid larval shrimp feed product. With Liqualife®, shrimp larvae benefit from more consistent nutrition, cleaner water and a much healthier tank environment than using conventional dry feeds. Studies show that when compared to conventional feeding programs, LiquaLife® can help prevent the accumulation of ammonia-N in culture tank water because there is less feed consumption and rapid growth. With Liqualife® shrimp feed, the return on investment can be maximized by having larger, healthier and more shrimp to sell at harvest time.

Cargill's small aquafeed strategy

"Our strategy is clear. Cargill Aqua Nutrition North America aims to be the leader in small aquafeed nutrition. We have a product range suitable for numerous species of finfish, freshwater, saltwater, cold water and warm water. We have liquid-based diets specially formulated for the earliest stages of larval shrimp production followed by first feeding applications to produce world class production and broodstock shrimp," said Gareth Butterfield, Sales Director for CQN NA, Canada plant. "All of our diets are formulated on the back of world class knowledge and research in fish nutrition. Our production flexibility ensures our offerings meet the needs of most farmers, from crumbles to micro-extruded feeds, with high performance formulations of cost-conscious product lines. Regardless of the species, the environment, the production type, CQN NA has a solution to meet the needs of any small fish producer," said Gareth.

CQN North America starter products let stocks grow faster, survive better, improve size uniformity and feed conversion, all of which translates to improved value and higher profitability.

Andrew Lawrence, Sale Representative
Cargill Aqua Nutrition
E: andrew_lawrence@cargill.com
E: Ewosca_Cs@cargill.com (Canada)
E: Usaqua_FeedOrders@Cargill.com (Franklinton)

Industry Events

Send your meeting details to: editor@hatcheryfeed.com

April 10 - 11

9th European Algae Industry Summit, Lisbon, Portugal

https://www.wplgroup.com/aci/event/european-algae-industry-summit/

April 11 - 12

Food and Feed Drying Technology Course, Ås, Norway

https://www.fie.com.au/events/drying-norway

April 15 - 17

Aquaculture Extrusion Technology Course, Ås, Norway

https://www.fie.com.au/events/aquafeed-extrusion-norway

April 28 – May 3

23rd International Seaweed Symposium, Jeju, Korea

https://www.iss2019.org/

May 7 - 9

Seafood Expo Global

https://www.seafoodexpo.com/global/

May 21 - 24

43rd Annual Larval Fish Conference, Majorca, Spain

https://imedea.uib-csic.es/sites/lfc-2019/

June 12 - 14

VICTAM International 2019, Cologne, Germany

https://victaminternational.com/

June 12

12th Aquafeed Horizon Conference, Cologne, Germany

http://feedconferences.com/

June 18 – 21

Asian-Pacific Aquaculture 2019, Chennai, India

https://www.was.org/meeting/code/APA2019

July 15 - 17

Applied Food and Feed Extrusion, Bangkok, Thailand

https://www.fie.com.au/events/applied-food-feed-extrusion-thailand

September 10 - 11

Aquaculture Innovation Europe, London, UK

https://aquaculture-innovation.com/events/aquaculture-2019

September 26 - 28

Intensive Shrimp Farming Technology, Singapore

https://www.aquaculturesg.org/intensive-shrimp-farming-2019.html

October 7 - 10

Aquaculture Europe 2019

https://www.aquaeas.eu/uncategorised/402-welcome-to-aquaculture-europe-2019

November 4 - 6

Aquafeed Extrusion Technology, Temuco, Chile

https://www.fie.com.au/events/aquafeed-extrusion-south-america

November 19 - 22

Latin American & Caribbean Aquaculture 2019, San José, Costa Rica

https://www.was.org/meeting/code/lacqua19

Hatchery Mart

The virtual marketplace

COMPLETE FEED —BROODSTOCK

COMPLETE FEED —LARVAL

LIVE FEEDS — ALGAE

Hatchery Mart

LARVAL FEED —ALGAE

LARVAL FEED — ZOOPLANKTON

Visit: hatcheryfeed.com to view online: links are live in digital editions.

PROBIOTIS

PROTEIN

WATER CONDITIONERS

FEED EQUIPMENT

Marketplace Directory

Aliga
http://aliga.dk/

Alltech Coppens
www.alltechcoppens.com

Extru-Tech
www.extru-techinc.com

Inve
www.inveaquaculture.com

Lallemand
www.lallemandanimalnutrition.com

ProCheate
www.prochaete.com

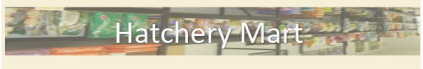
Reed Mariculture
www.reedmariculture.com

Skretting
www.skretting.com

Sparos Lda
http://sparos.pt

Tom Algae
http://www.tomalgae.com

Zeigler
www.zeiglerfeed.com



Let's get your products in Hatchery Mart

sales@aquafeed.com

ASIAN PACIFIC AQUACULTURE 2019

APA'19

This event includes:

Asian Pacific Aquaculture 2019

ISTA 2019

Chennai Trade Center

Chennai - Tamil Nadu - India

June 19 -21, 2019

Aquaculture for Health, Wealth and Happiness

APA'19

CHENNAI - INDIA

JUNE 19 - 21

Hosted by: Tamil Nadu Fisheries University

Organized by: World Aquaculture Society - Asian Pacific Chapter

For more information contact conference manager:

P.O. Box 2302

Valley Center, CA 92082 USA

Tel: +1.760.751.5005

Fax: +1.760.751.5003

worldaqua@was.org - www.was.org

Trade show & Sponsorship:

mario@marevent.com

WORLD AQUACULTURE Society

ASIAN PACIFIC CHAPTER WORLD AQUACULTURE SOCIETY