Autolyzed yeast and gilthead sea bream (*Sparus aurata*) nutrition: effects on fish growth performance and gut morphology

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Pordenone fiera, 16 gennaio 2017

Welfare first of all

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Applied Animal Behaviour Science 86 (2004) 205–223
www.elsevier.com/locate/applanim

Stress and the welfare of cultured fish

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APPLIED ANIMAL BEHAVIOUR SCIENCE
Applied Animal Behaviour Science 104 (2007) 199–235
www.elsevier.com/locate/applanim

Fish welfare: Current issues in aquaculture

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The "functional ingredient" age

Fish & Shellfish Immunology 36 (2014) 525–544

Contents lists available at ScienceDirect

Fish & Shellfish Immunology

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

Improved health and growth of fish fed mannan oligosaccharides: Potential mode of action

Silvia Torrecillas*, Daniel Montero, Marisol Izquierdo

Grupo de Investigación en Acuicultura (GIA), Universidad de Las Palmas de Gran Canaria, Transmontaña s/n, Arucas, 35416 Las Palmas de Gran Canaria, Canary Islands, Spain

Fish Physiol Biochem (2013) 39:431–457
DOI 10.1007/s10695-012-9710-5

Beta-glucan: an ideal immunostimulant in aquaculture (a review)

D. K. Meena · Pronob Das · Shailesh Kumar · S. C. Mandal · A. K. Prusty · S. K. Singh · M. S. Akhtar · B. K. Behera · Kundan Kumar · A. K. Pal · S. C. Mukherjee

Journal of Applied Microbiology

Journal of Applied Microbiology ISSN 1364-5072

REVIEW ARTICLE

The use of probiotics in aquaculture

N.V. Hai

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- Additives such as prebiotics, probiotics, immunostimulants and nucleotides have been feed included for improving fish health and immune status
- Favourable gut conditions, diet digestibility, absorption and fish wellness have been also enhanced

Welfare and nutrition

Among other causes:

a. stressful rearing conditions

b. sub-optimal dietary nitrogen formulation


Fish Physiol Biochem (2012) 38:119–141
DOI 10.1007/s10695-011-9592-y

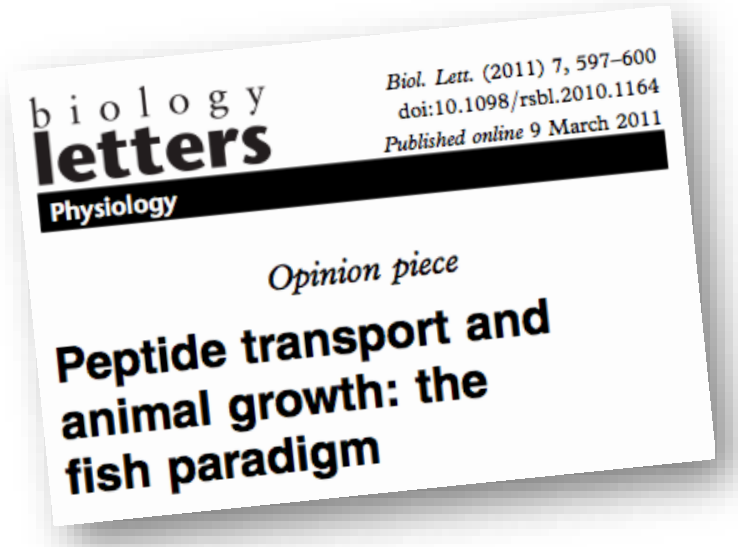
Dietary nitrogen and fish welfare

Luis E. C. Conceição · Cláudia Aragão · Jorge Dias · Benjamín Costas · Genciana Terova · Catarina Martins · Lluis Tort

may negatively affect amino acids metabolism

and fish welfare can be dramatically compromised (Conceicao et al. 2012)

The role of feed nitrogen sources…



Hence, a suitable diet nitrogen composition in term of protein, amino acids, peptides, nucleotides and so on, may be crucial to maintain an appropriate fish welfare

moreover, teleost can efficiently use dietary di/tri-peptides for development, growth, and metabolism

as a consequence, a balanced peptide-based diet might be beneficial in solving the nutritional inadequacy problems of formulated feeds for farmed fish (Verri et al., 2011)

How can we pursue this goal …

J Comp Physiol B
DOI 10.1007/s00360-016-1044-7

REVIEW

Di- and tripeptide transport in vertebrates: the contribution of teleost fish models

Tiziano Verri[1] · Amilcare Barca[1] · Paola Pisani[2] · Barbara Piccinni[1] · Carlo Storelli[1] · Alessandro Romano[3]

Results observed in recent studies suggest that fish may effectively "use" diet peptides (Verri et al., 2016); hence, to pursue our goal it should be taken under consideration:

- the feed inclusion of peptides rich ingredients
- to limit the use of vegetal protein sources (to avoid side effects of anti-nutritional elements, reduced digestibility, etc.)
- Promoting the use of raw materials containing "nutraceutical" nutrients (e.g. chitin, B-glucans, AMPs, etc.)
- **Differentiating nitrogen sources as much as possible**

Introduction

… and the perspective of fishmeal shortage

Animal Feed Science and Technology 203 (2015) 1–22

Contents lists available at ScienceDirect

Animal Feed Science and Technology

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

Review

Review on the use of insects in the diet of farmed fish: Past and future

M. Henry [a,*], L. Gasco [b], G. Piccolo [c], E. Fountoulaki [a]

Available online at www.sciencedirect.com

ScienceDirect

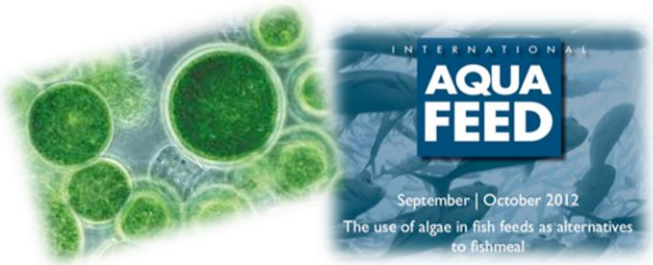
Aquaculture 266 (2007) 219–225

Aquaculture

www.elsevier.com/locate/aqua-online

Effect of total replacement of dietary fish meal by low fluoride krill (*Euphausia superba*) meal on growth performance of rainbow trout (*Oncorhynchus mykiss*) in fresh water

Bunji Yoshitomi [a,*], Masatoshi Aoki [b], Syun-ichirou Oshima [b]



J Appl Phycol
DOI 10.1007/s10811-017-1281-5

Microalgae as a potential ingredient for partial fish meal replacement in aquafeeds: nutrient stability under different storage conditions

J. Camacho-Rodríguez [1] · M. D. Macías-Sánchez [1] · M. C. Cerón-García [1] · F. J. Alarcón [2] · E. Molina-Grima [1]

Aim of the trial

Aim: comparing the effects of 2 nitrogen-rich ingredients on gilthead sea bream (*Sparus aurata*)

Sources:

1. hydrolyzed fish protein (HFP)
2. autolyzed yeast (HiCell, Biorigin – Brazil)

Both raw material were compared to fishmeal as "control" ingredient

Fish, rearing conditions and feeding

Fish:

720 gilthead sea bream

Initial BW 122.18±6.226 g

Rearing conditions:

Experimental Center of VRM srl Naturalleva®, Civitavecchia (Italy)

2000 liters fiberglass tanks (80 fish/tank, 1.83±0.042 kg/m^3)

flow-through system and 3 daily water changing

Temperature 24.5 ± 2.26 °C throughout the experimental period

DO level 10 mg/L

Experimental design and feeding program:

3 groups x 3 replicates

feed distribution twice a day, until visual satiety

12 weeks experimental period

4.5 mm diameter pellets (VRM S.r.l, Naturalleva, Italy)

Measured parameters

Measured parameters:

- Initial Body Weight (Bwi)
- Final Body weight (BWf)
- Body Weight gain (BWg)
- Feed Intake (FI)
- Feed Conversion Rate (FCR)
- Mortality events were recorded on daily bases and dead fish BWf recorded for FCR calculation

Samples and analysis:

- histological analysis of the intestine
  - general morphology
  - goblet cell density

Diets

Diets formulation and proximate composition

Ingredients	FM	FPH	AY
Fishmeal	**22**	**18**	**18**
Fish protein, hydrolyzed		**5**	
HiCell® - autolysed yeast			**5**
Fish oil 92	7	7	7
Soybean meal	11	11	11
Guar germ meal	15	14	18
Wheat middling	7	9	7
Corn gluten meal	18	17	18
Pea meal	4	4	2
SPC	9	10	10
Rapeseed oil	1	1	1
Cameline oil	2	2	2
Min./Vit. supplement	2	2	2
Total	100	100	100

Parameters	FM	FPH	AY
Protein (%)	46.1	46.1	46.1
Fat (%)	16.2	16.1	16.1
Ash (%)	6.2	5.8	6.0
Fiber (%)	2.1	2.0	2.2
Gross Energy (Mj/kg)	18.7	18.8	18.6
DE (Mj/kg)	17.2	17.3	16.8
DP (Mj/kg)	40.9	41.0	40.7
Fish Protein /Total Protein (%)	31.4	33.0	25.1
DP/DE (mg/kJ o g/MJ)	23.8	23.7	24.2
EPA (%)	0.6	0.5	0.5
DHA (%)	0.5	0.5	0.5
n3/n6	1	1	1
DHA/EPA	0.9	0.9	0.9
DE prot (%)	56.2	56.0	57.2
DE fat (%)	35.4	34.7	35.6
DE starch (%)	8.4	9.3	7.2

Growth performances

Most relevant growth performances of gilthead sea bream (*Sparus aurata*) fed FM, HFP, and AY

Parameter	Control			FPH			Hicell			P
	n	m	se	n	m	se	n	m	se	
BWi (g)	30	122.9	0.65	30	122.4	0.59	30	120.8	0.74	0.098
BWf (g)	30	248.2	4.92	30	245.5	4.92	30	252.0	4.92	0.645
SL (cm)	15	19.8	0.27 a	15	18.3	0.27 b	15	18.6	0.27 b	0.001
FI (kg)	3	16.1	0.22	3	15.9	0.22	3	15.4	0.22	0.192
FCR	3	1.5	0.03	3	1.5	0.03	3	1.6	0.03	0.391

Unexpectedly:

- a SL reduction was observed for fish fed HFP and AY
- similar results have been observed on sea bass (Torrecillas et al. 2017)
- the biological meaning of this observation remains unclear

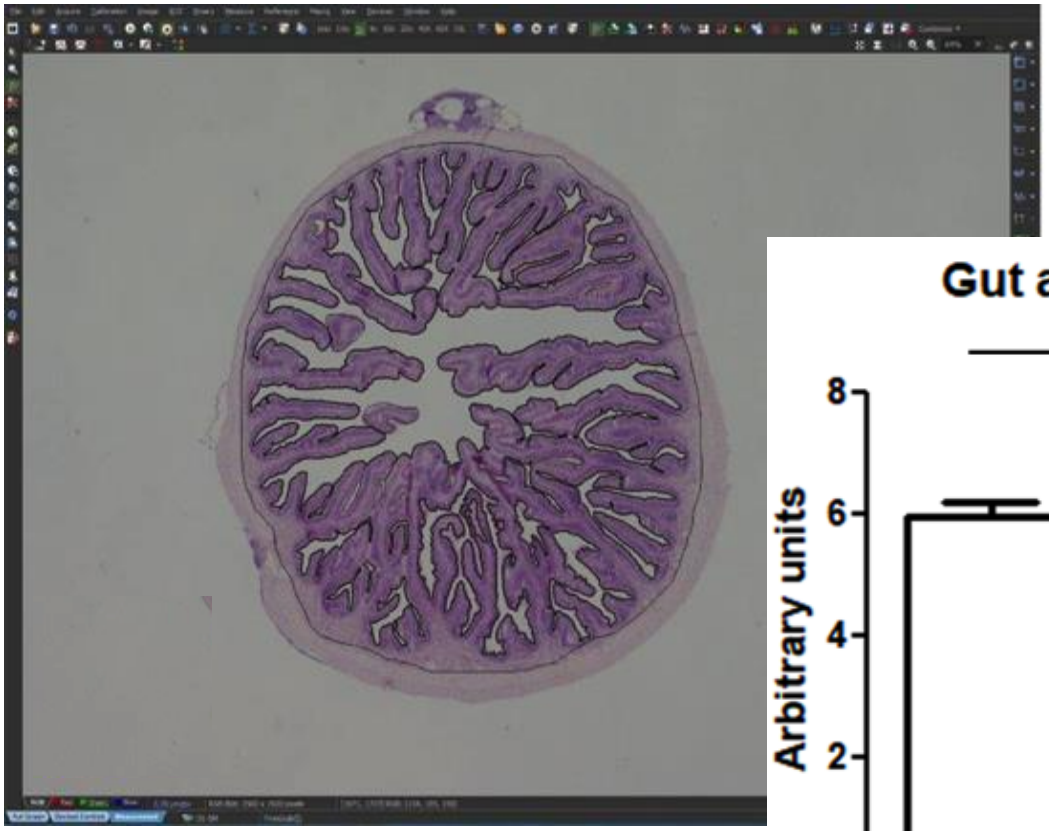
Intestine morphological traits

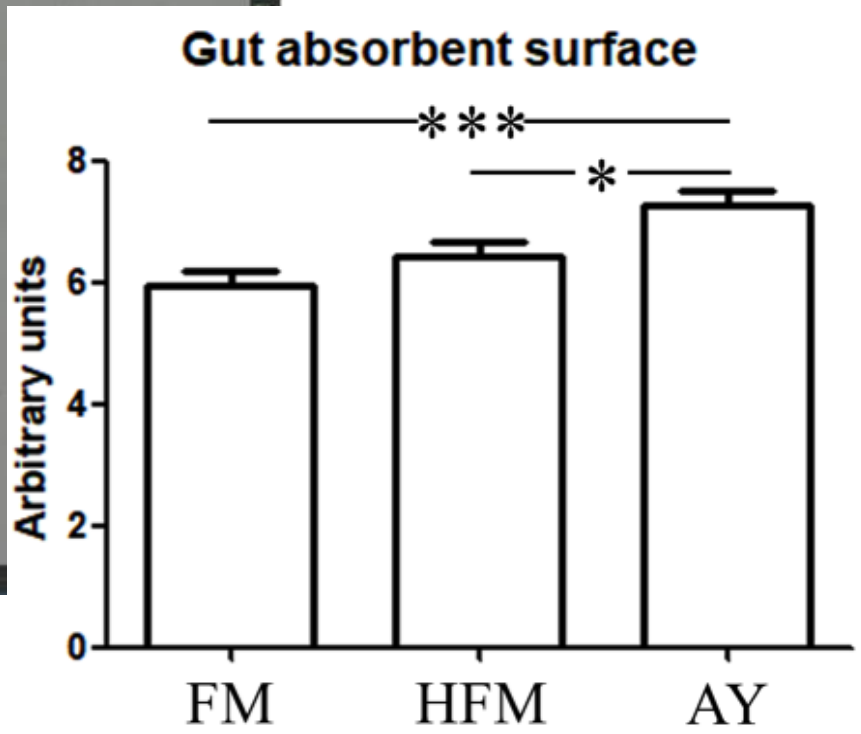
Histological differences of the anterior part of the mid-gut of gilthead sea bream (*Sparus aurata*) fed FM, HFM and AY

Group	Thickening	Branching	Oedema	Intraepithelial lymphocytes Score			Eosinophilic infiltrate of the submucosa Score		
				0	1	2	0	1	2
FM	0	0	2	10	2	0	11	1	0
HFM	1	6	4	7	5	0	8	4	0
AY	4	11	3	4	8	0	8	4	0

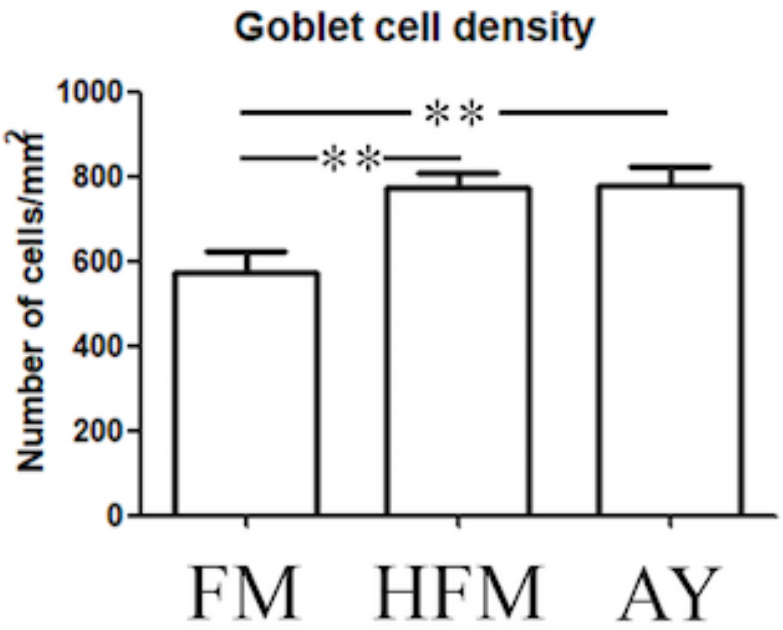
- Eosinophilic infiltrate is a possible trigger of acute mucin secretion (Laboisse et al. 1996)
- Increased gut ECGs, suggests the influence on GALT regulation (Torrecillas et al., 2011)
- Thickening and branching may be related to the gut absorbent surface enhancement observed for AY groups

Intestine morphological traits





Intestine morphological traits



- In HFM and AY groups, goblet cells were found not only on the epithelial surface but also stratified within the epithelial thickness;
- a stratified disposition of goblets within mucous cells may indicate exposure to a secretagogue with cells undergoing compound exocytosis such as **mucins** (Deplancke and Gaskins 2001)

AY: a new opportunity

AY showed a good potential as FM and HFP replacer in gilthead seabream nutrition thanks to:

a. comparable growth performances

b. enhancement of relevant morphological traits of the intestine such as:
   - absorbent surface
   - goblet cell density

Quite similar morphological effects have been reported and considered as a positive enhancement of gut performances (Torrecillas et al., 2011)

Thank you for your kind attention

Also, many thanks to the team members:

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- Prof. Vincenzo Miragliotta (DSV – UniPi)
- Dott. Fabio Brambilla (VRM srl – Naturalleva)
- Prof. Mahanama De Zoysa (CNU – South Korea)

and to

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- Albitalia (Milano – Italy)