Farmed fish quality and welfare monitoring using proteomics

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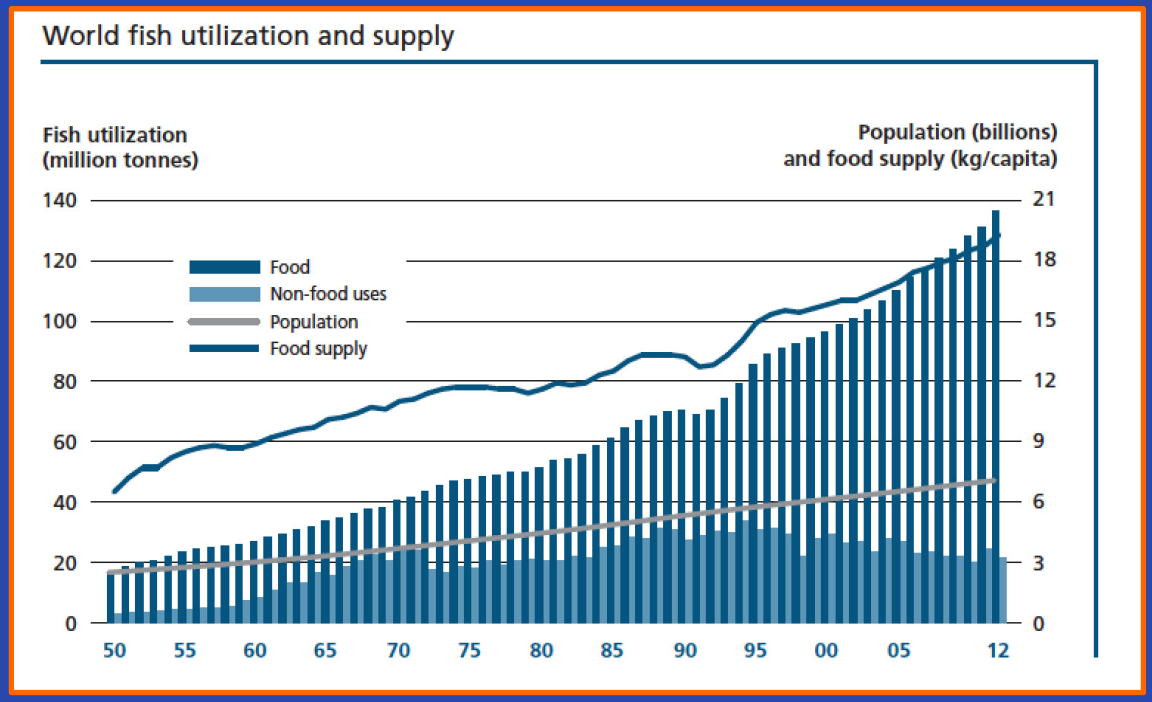
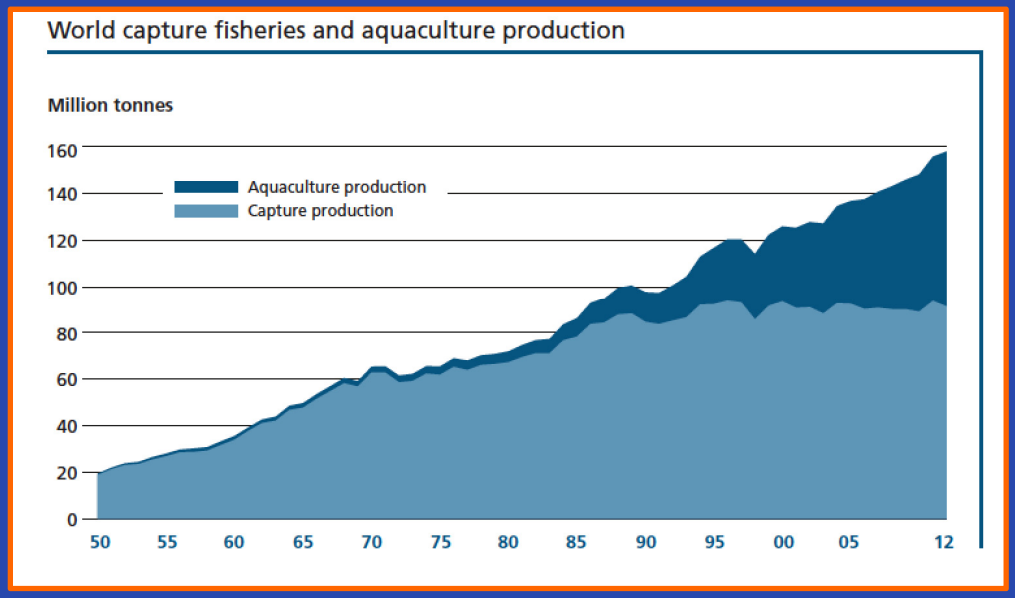
Fish Consumption / Aquaculture

Food Fish supply is increasing at an average annual rate of 3.2%, accounting for almost 17% of the global population's intake of protein.



FAO 2014

Aquaculture



FAO 2014

Extremely competitive market

Today's presentation

Fish Welfare → Fish Welfare is complex definition often related to fish well-being. Depends on good management practice

Fish quality → Fish quality is a broad and complex concept affected by a genetic basis and management systems

PR1

Contents lists available at ScienceDirect

Aquaculture

journal homepage: www.elsevier.com/locate/aqua-online

Metabolic molecular indicators of chronic stress in gilthead seabream (*Sparus aurata*) using comparative proteomics

Ricardo N. Alves [a], Odete Cordeiro [a], Tomé S. Silva [a], Nadège Richard [a], Mahaut de Vareilles [a], Giovanna Marino [b], Patrizia Di Marco [b], Pedro M. Rodrigues [a], Luís E.C. Conceição [a,*]

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Welfare Evaluation → Stress response

Fish Welfare

Dias nummer 5

PR1 biological and physiological responses of an organism to conditions that affect it – The Stress response.

Pedro Rodrigues, 24/08/2014

Classical approach

Classical parameters used as stress indicators

- Cortisol
- Lactate
- Glucose
- Total protein in plasma
- Haematocrit and haemoglobin
- Enzymatic assays

- Fish respond differently to stress
- Cortisol levels can often return to basal due to adaptation processes

The proteomics approach

Experimental

2

Control (CTRL)

6x 

2

Regular handling (HND)

6x 

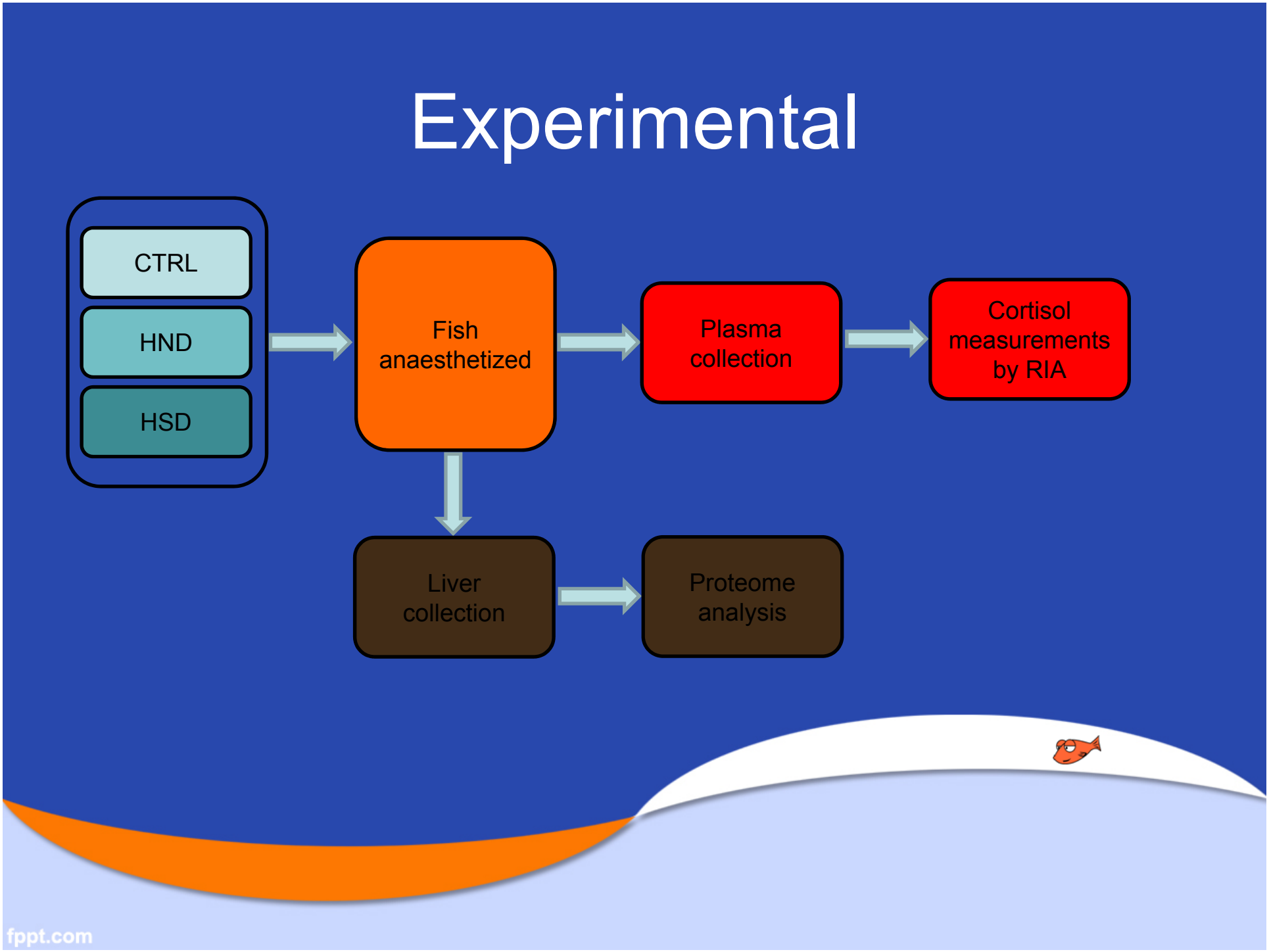
1min , twice/week

2

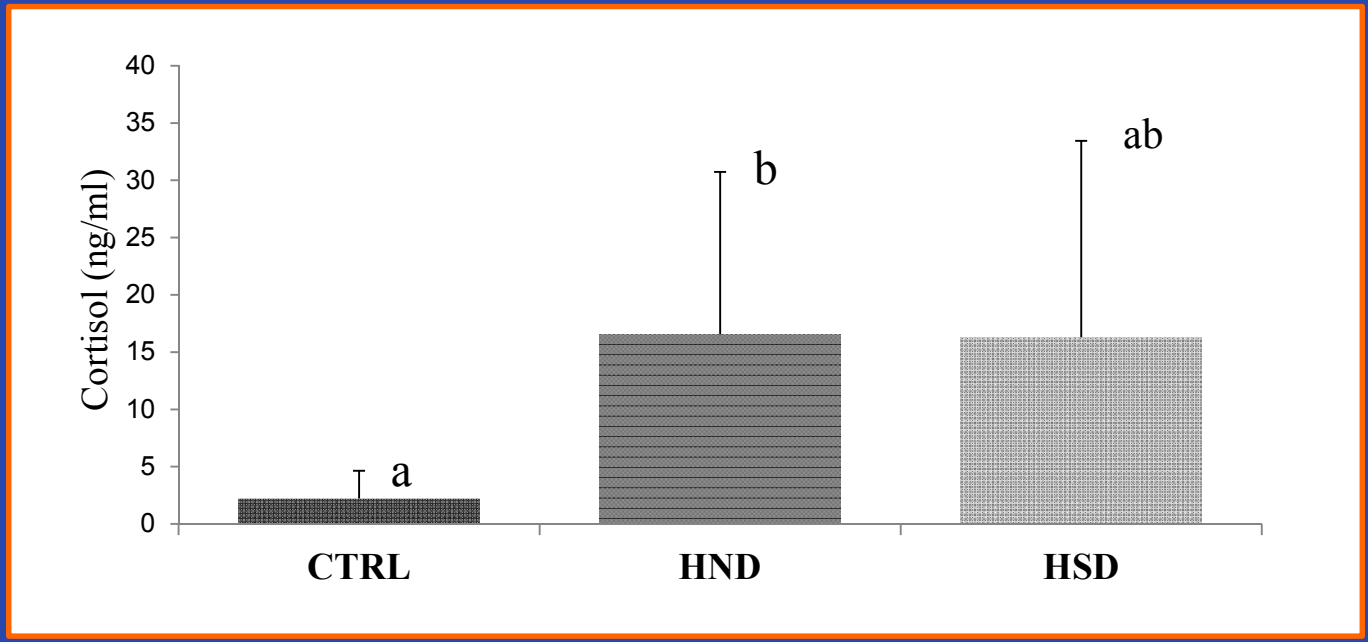
High stock density (HSD)

11x 

Experimental

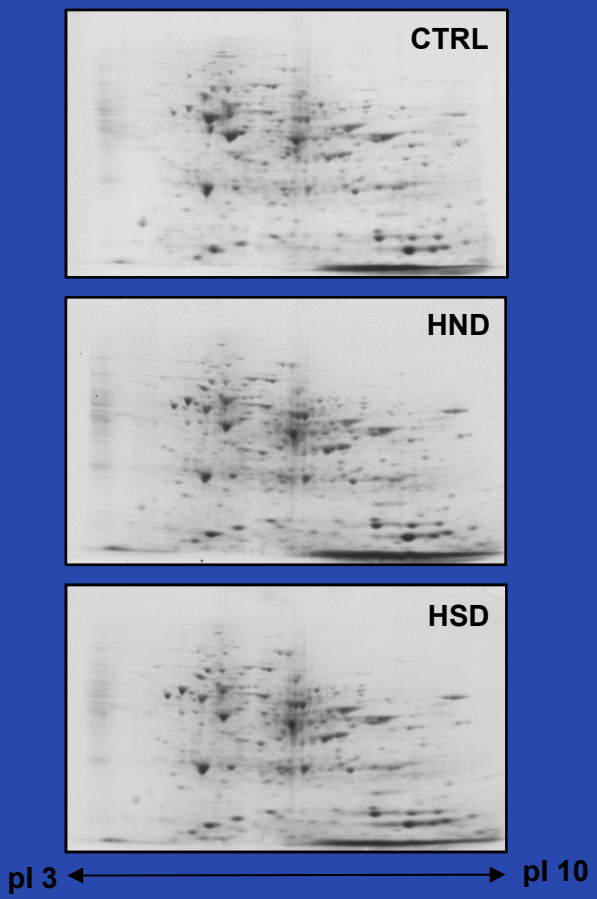


Results



Mean plasma cortisol concentration

Results



560 spots acquired

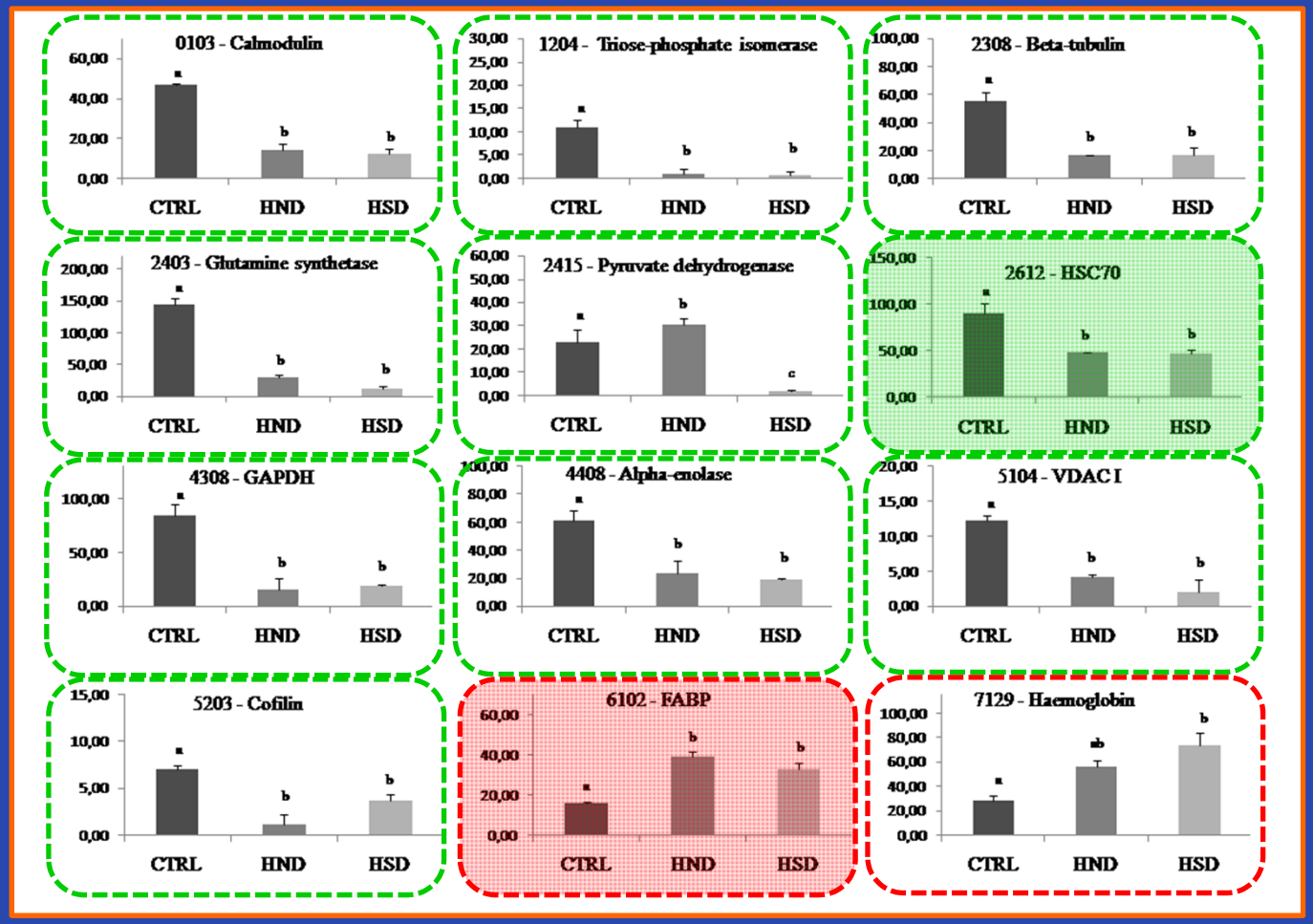
299 spots differentially expressed between CTRL and stressed fish (HND and HSD)

164 relevant spots (greater than 2-fold or lower than 0.5-fold expression)

79 up-regulated spots and 85 down-regulated spots in response to stress

35 spots changed in HND

40 spots changed in HSD



Up-regulated

Down-regulated

Discussion

Spot 2612 - Heat shock cognate protein 70

- Lower gene expression of hsc70 in brain liver of fish subject to high rearing densities (Gornati et al., 2004)

-Immunohistochemical techniques reveal that this protein only accumulates in the
al., 2007)

ck and
ed a
decrease
f HSPs70
Vijayan,
2002b)

-HSPs

- Very conser

- Cha

-Important role in folding

-Regulation, secretion and degradation

Both results suggest that hsc70 is a very good candidate to be used as a biomarker for fish welfare

Discussion

Spot* 6102 – *Fatty acid binding protein (FABP)

-Increase in the expression in the liver of stressed fish observed in this study can be explained as a mechanism to sustain high rates of lipid usage in liver cells, in order to respond to the increased

o stress.

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Montero
nd Erol et

- FABPs

- Transpor
maintenance of

- Uptake of
inte

-Accumulation of fatty acids in the cytosol

- genetic regulation and fatty acid signaling

FABP is a potential biomarker candidate for fish welfare

Overall

Proteomics presents itself as a new approach to evaluate chronic stress in gilthead seabream and likely in other species.

Future work

Validation studies on gene expression (RT-PCR), Immunoassays, and enzymatic activities, as well as in a broader range of chronic stress situations and different species, are required before these biomarkers can be used as chronic stress indicators in fish.

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

Article

pubs.acs.org/JAFC

Effects of Preslaughter Stress Levels on the Post-mortem Sarcoplasmic Proteomic Profile of Gilthead Seabream Muscle

Tomé S. Silva,*[†,§] Odete D. Cordeiro,[†] Elisabete D. Matos,[†] Tune Wulff,[§] Jorge P. Dias,[†] Flemming Jessen,[§] and Pedro M. Rodrigues[†]

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Pre-slaughter handling

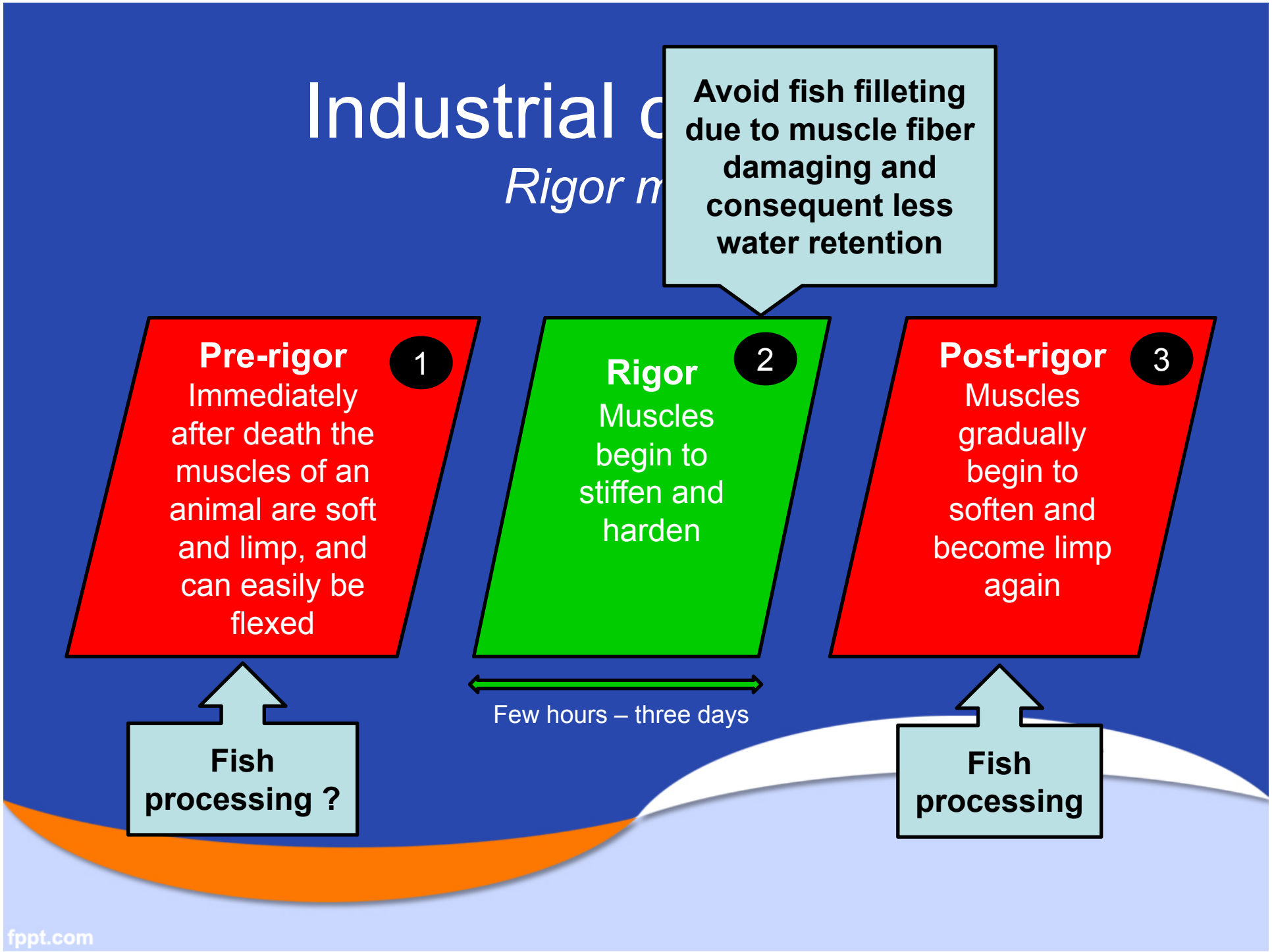
Muscle cellularity

Fish quality

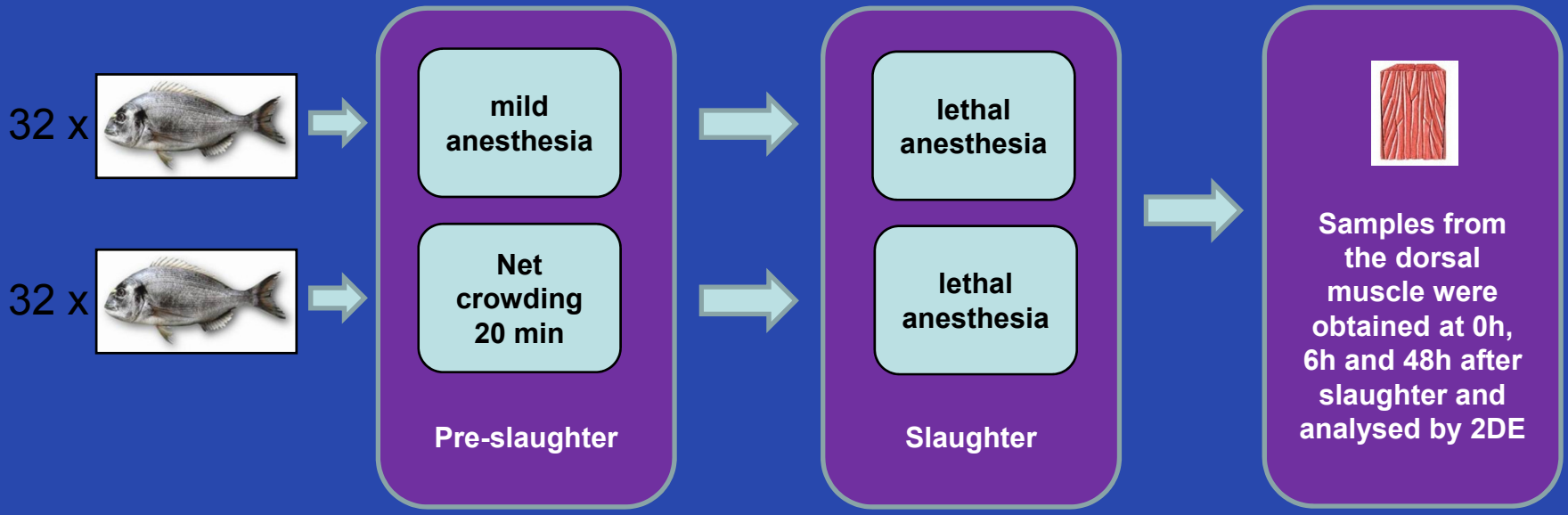
Quality Assesment

Rigor mortis

Rigor mortis - the stiffening of the muscles of an animal shortly after death. Greatly affects the quality of fish frozen very soon after capture.

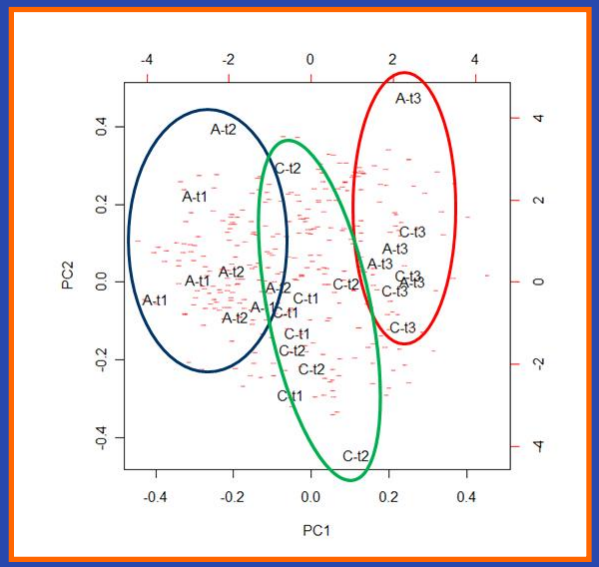

Industrial c
Rigor m
Avoid fish filleting due to muscle fiber damaging and consequent less water retention
Pre-rigor
1
Immediately after death the muscles of an animal are soft and limp, and can easily be flexed
Rigor
2
Muscles begin to stiffen and harden
Post-rigor
3
Muscles gradually begin to soften and become limp again
Few hours – three days
Fish processing ?
Fish processing
fppt.com

Experimental design



Results

Principal component analysis PCA



311 spots

mild Anesthesia

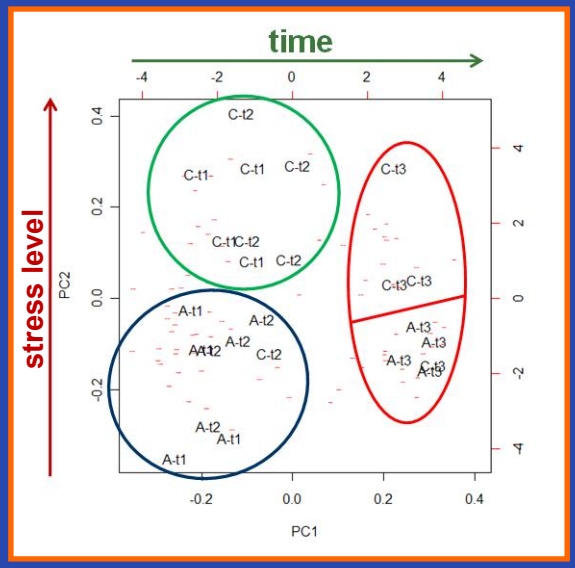
A-t1 (0h after slaughter)
A-t2 (6h after slaughter)

A-t3 (48h after slaughter)

net Crowding

C-t1 (0h after slaughter)
C-t2 (6h after slaughter)

C-t3 (48h after slaughter)

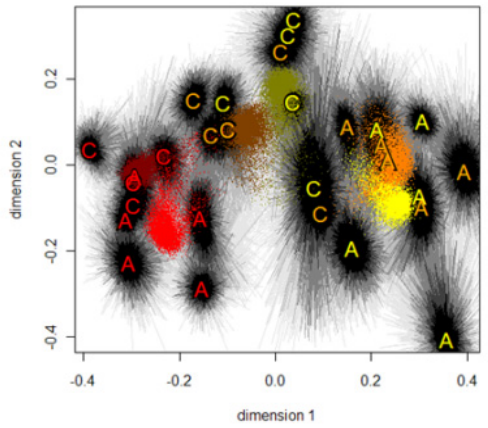


79 spots (after PLSR)

Results

Multidimensional scaling

(net Crowding / Anesthesia) and the sampling time



• [0h] • [6h] • [48h]

SameSpots™

-Significant differences between treatments (A/C) are observed especially at 0H and 6H.

-Proteome transformations seem to happen in the first hours post-morten.

-Significant differences between pre-rigor points at 0H and 6H are observed but C treatment seems to have a closer relation to points at 48H (post-rigor) than A treatment.

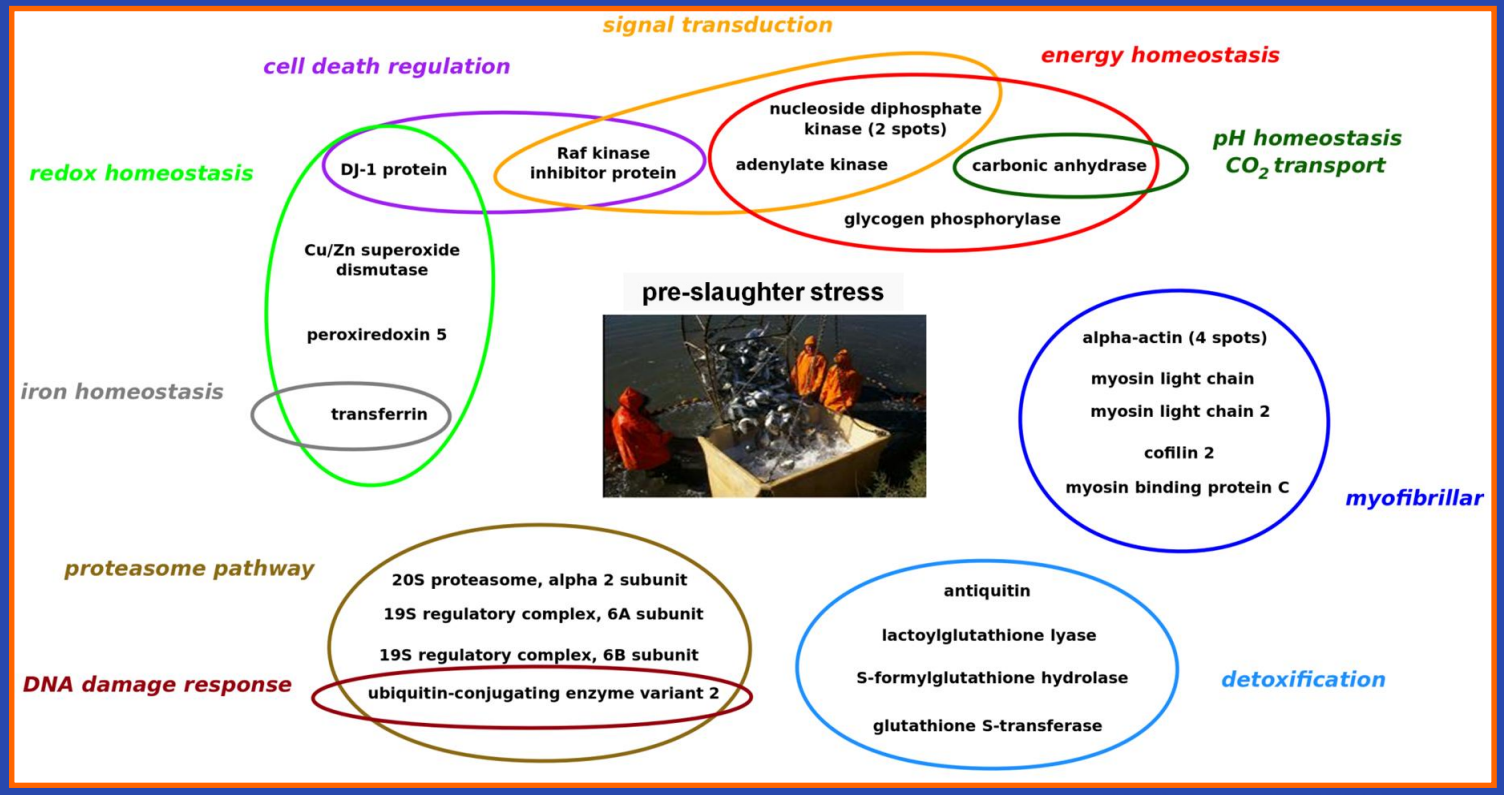
-Stress seems to accelerate the process of rigor.

Results

Relative robustness of gilthead seabream muscle properties to pre-slaughter stress. There were no observable differences between groups in terms of texture properties (namely, hardness and cohesiveness of cooked and raw fillets).

Results

Affected cellular processes in gilthead seabream muscle



Overall

The sensitivity of proteomic data in detecting a biological response to certain stimulus, even when no differences are apparent according to macroscopic quality criteria.

Final Conclusion

Presented results underline the relevance of proteomics in the context of animal farming, particularly in the field of fish welfare, quality and industrial process optimization.

People involved

Pedro Rodrigues – Assistant Professor at UALG and researcher of the aquaculture group at CCMar

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Ricardo alves – Masters student University of Algarve (aquaculture group)

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