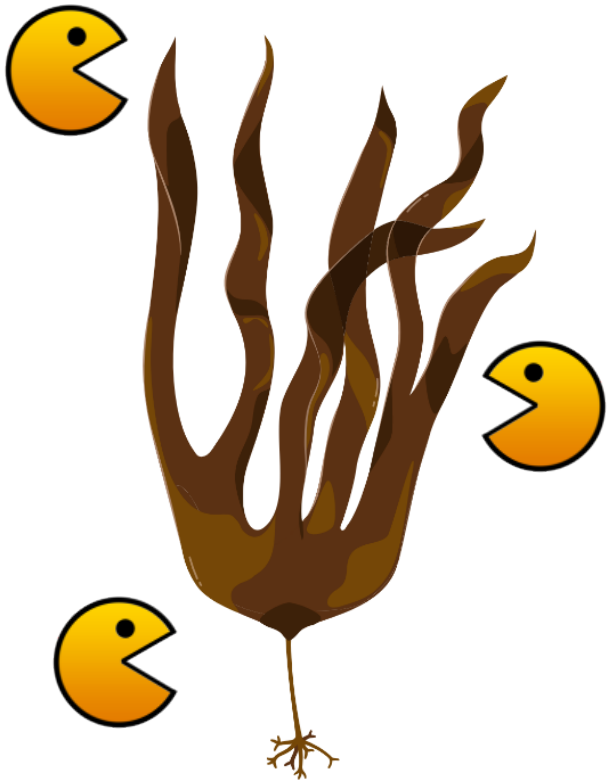
The effect of dietary *Laminaria digitata* on the muscle proteome and metabolome of weaned piglets



D. M. RIBEIRO, D. F. P. CARVALHO, C. C. LECLERCQ, S. CHARTON, K. SERGEANT, E. COCCO, J. RENAUT, J. A. M. PRATES, J. P. B. FREIRE, A. M. ALMEIDA

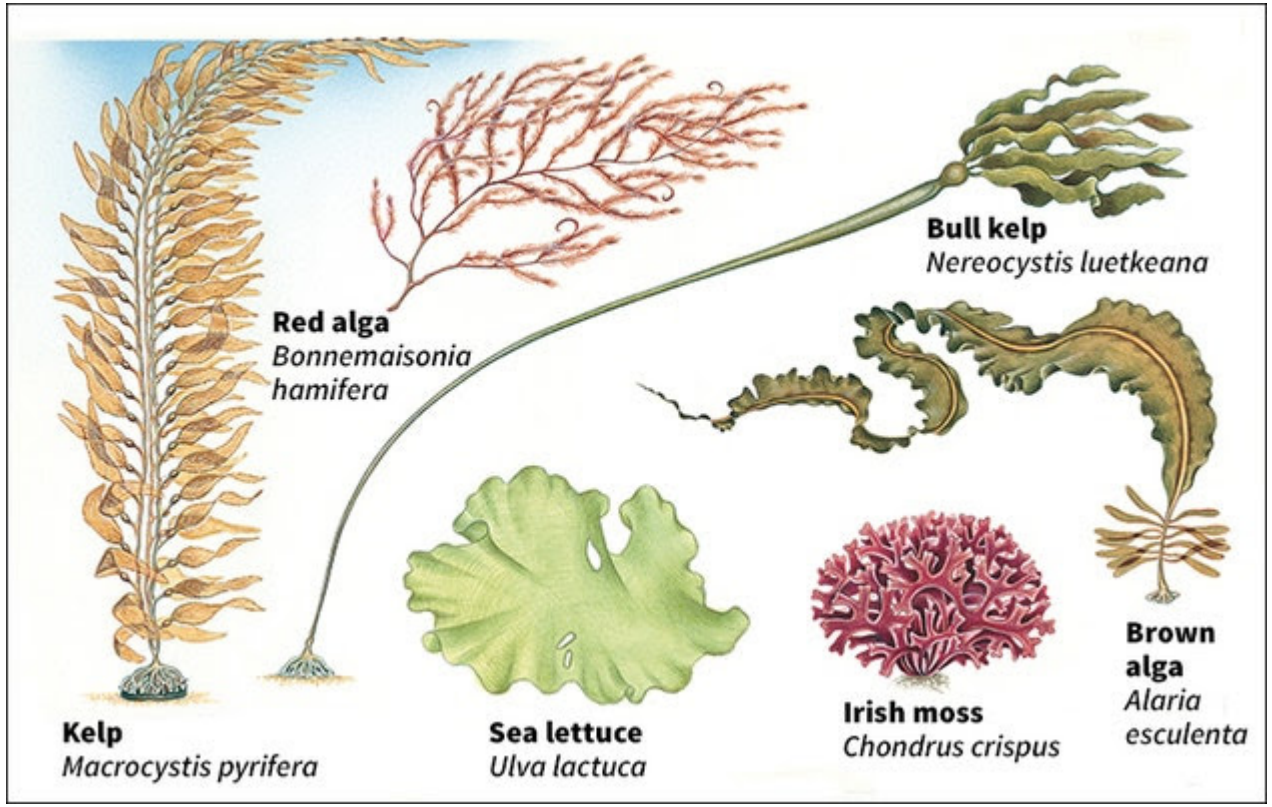
Fundação para a Ciência e a Tecnologia

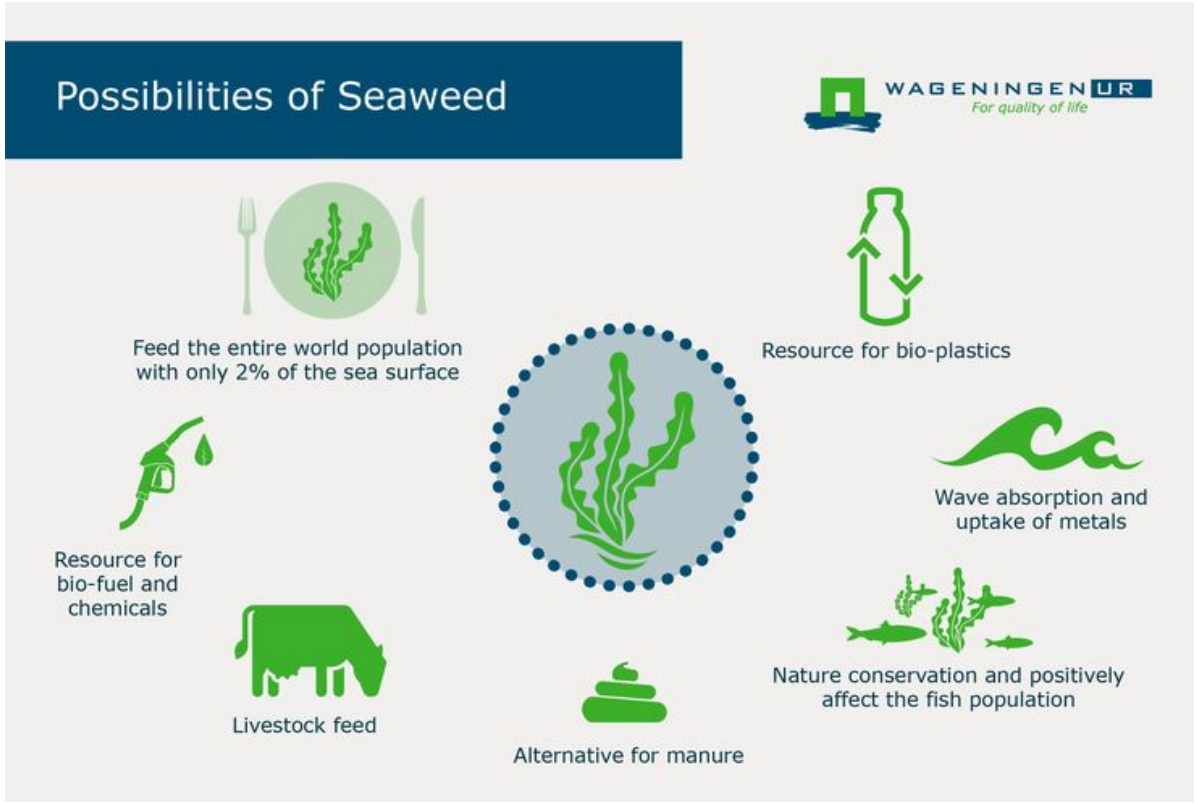
Outline

1. Background: what, why and how?
    1. What are seaweeds?
    2. Why use them as feed?
    3. How can they be fed to monogastrics?
    4. Objectives
2. Materials and methods
    1. Live animal trial
    2. Laboratory analysis
3. Results and discussion
    1. Effect of seaweed vs control
    2. Effect of seaweed + alginate lyase vs control
    3. Effect of alginate lyase vs seaweed
4. Conclusions and future perspectives

"Don't think of it as seaweed—think of it as a sea vegetable."

What are seaweeds?





Why seaweeds?

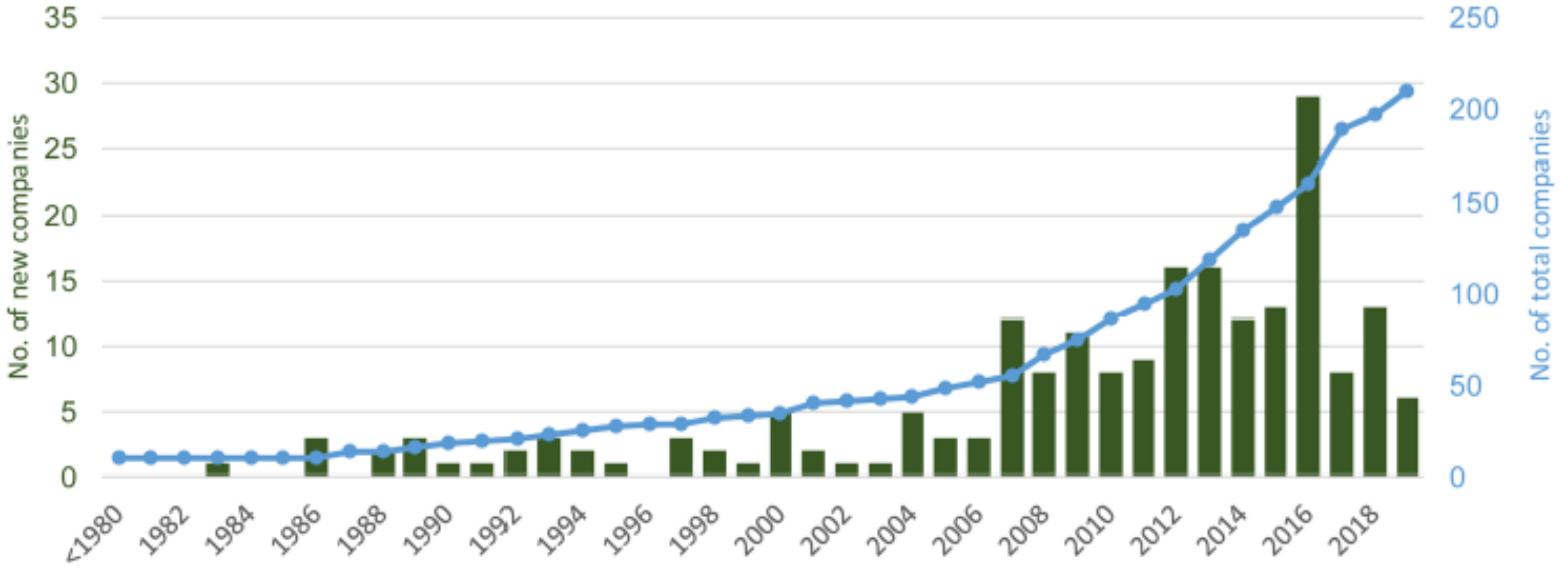
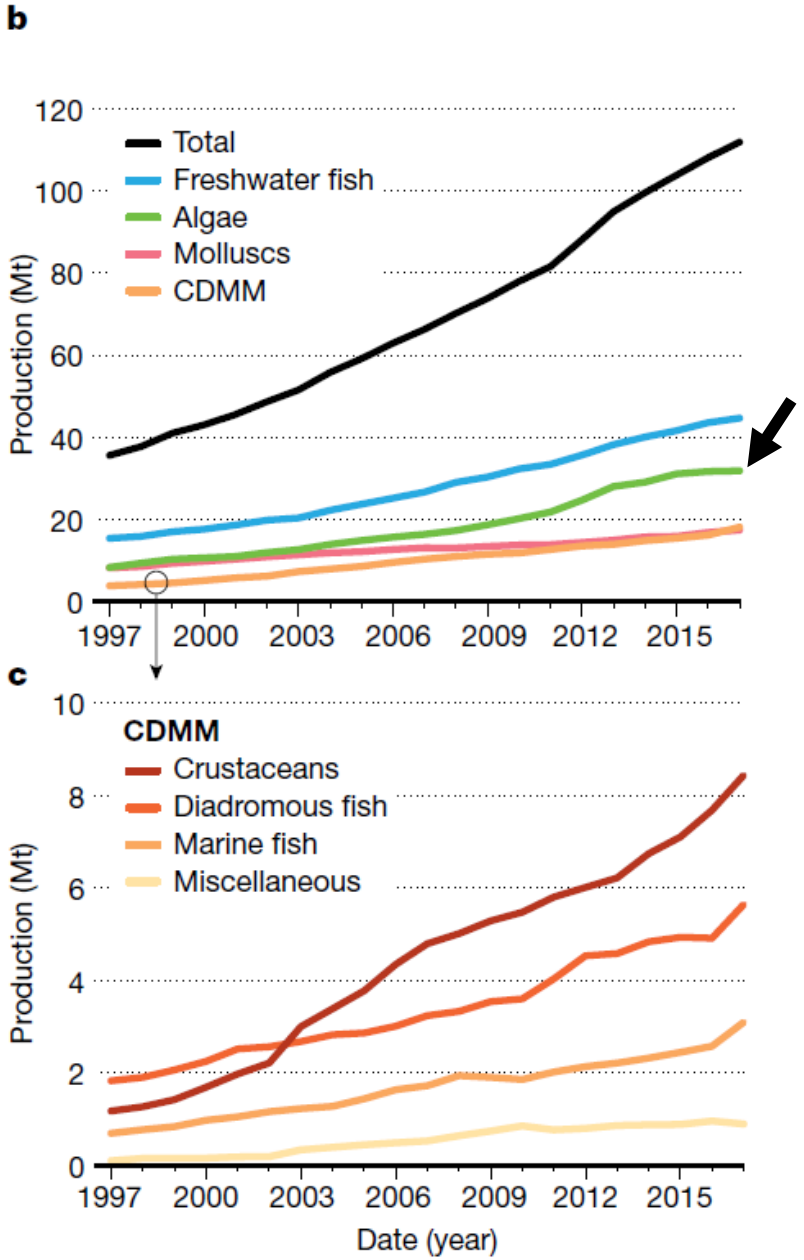


FIGURE 5 | Number of algae producing companies currently operating in Europe (starting activity since 1926). The values shown represent the number (left axis) and the accumulated (right axis) number of companies per year from the companies currently active.

(Araújo et al., 2021)



(Naylor et al., 2021)

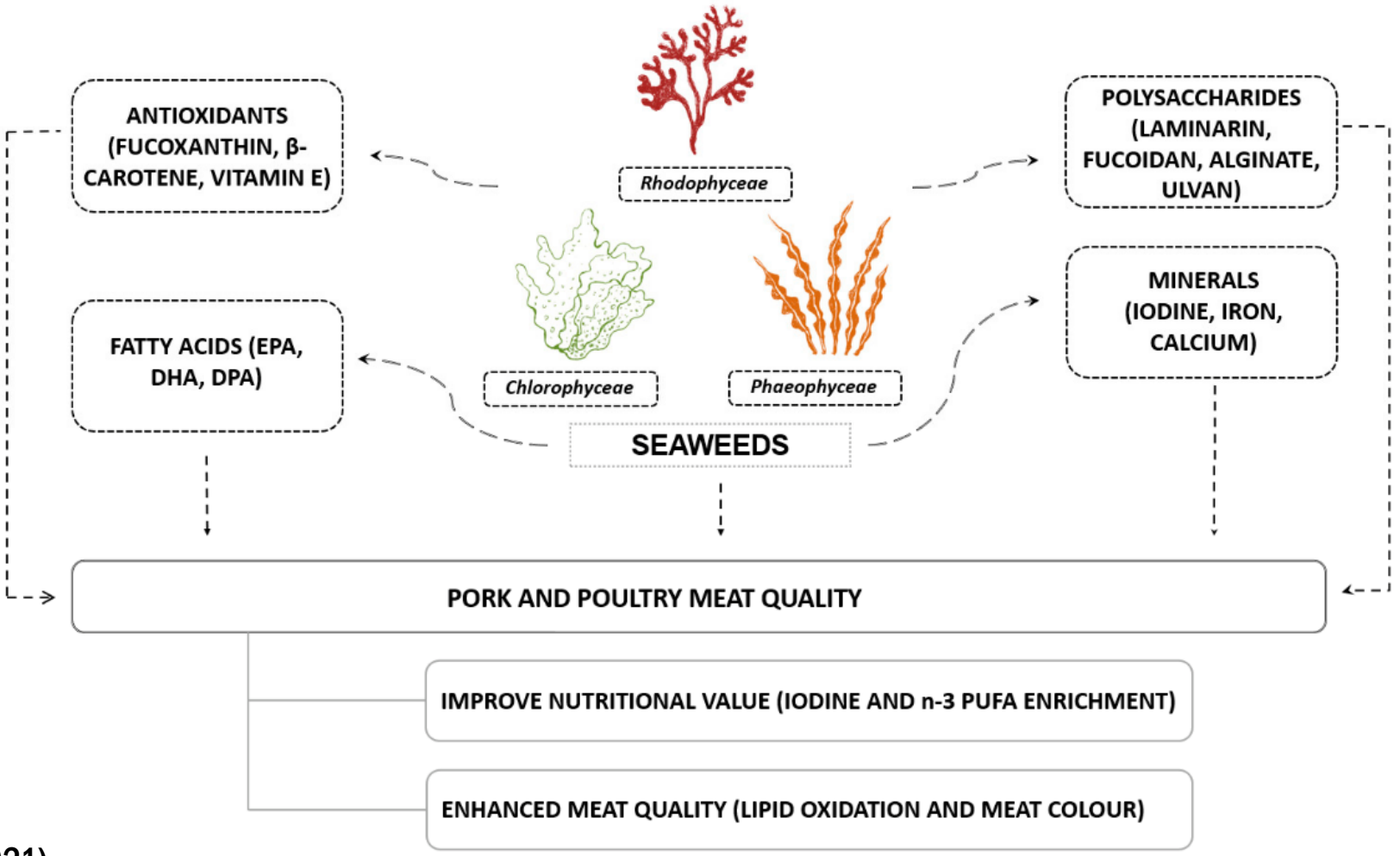
Why seaweeds?

Seaweed	Dry Matter	Ash	Crude Protein	Crude Fat	Crude Fibre	NDF	ADF	ADL
Phaeophyceae (brown)								
Laminaria japonica	97.5	14.9	20.5	3.0	13.3	35.6	28.8	N/A
Chlorophyceae (green)								
Ulva sp.	93.6	51.3	14.6	1.15	N/A	21.0	7.45	3.2
Rhodophyceae (red)								
Halymenia palmata	90.6	19.0	18.5	1.69	1.83	N/A	N/A	N/A

Units in % on a DM basis

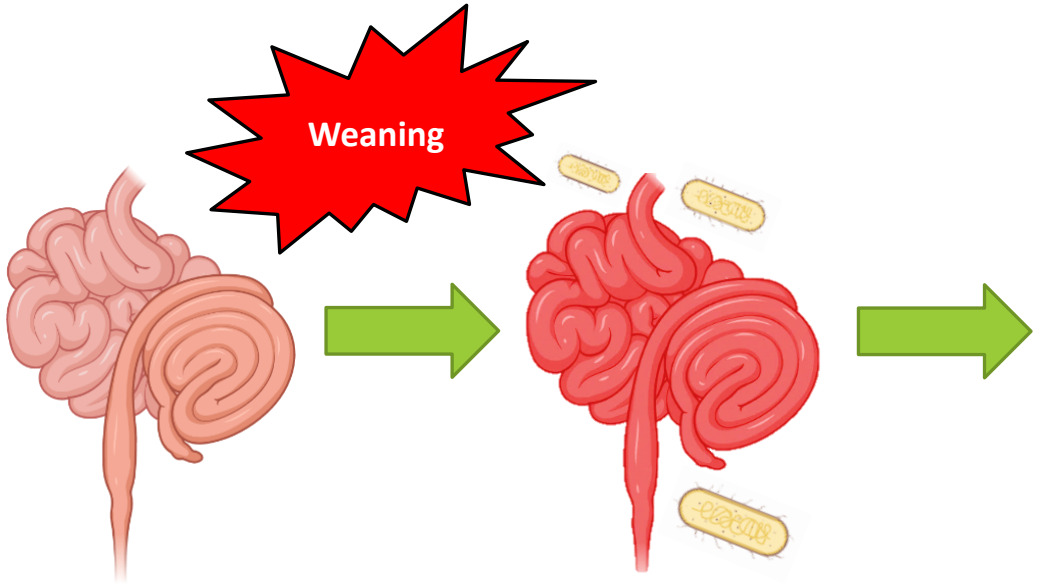
(Ribeiro et al. 2021)

Why seaweeds?



(Ribeiro et al. 2021)

Why feed them to piglets?



Pre-weaning gut

Post-weaning gut

- Low feed digestibility
- High intestinal permeability
- Enteric inflammation
- Post-weaning diarrhoea
- Depressed growth performance

Low animal welfare and farm profitability!

Solutions???

Objectives

Seaweeds have a recalcitrant cell wall that prevents an efficient monogastric digestion

To use *L. digitata* as functional ingredients in piglet diets

+

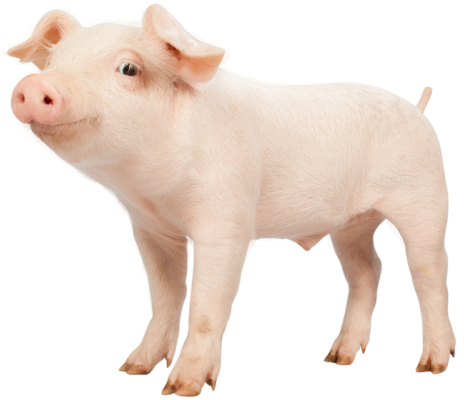
To evaluate the effect of alginate lyase supplementation to increase its potential

To our knowledge, no studies have reported >5% *L. digitata* incorporation in piglet diets

Effects on the muscle metabolism:

Mechanisms of adaptation?

Signs of stress?



Live animal trial

30 recently weaned Large White × Duroc piglets

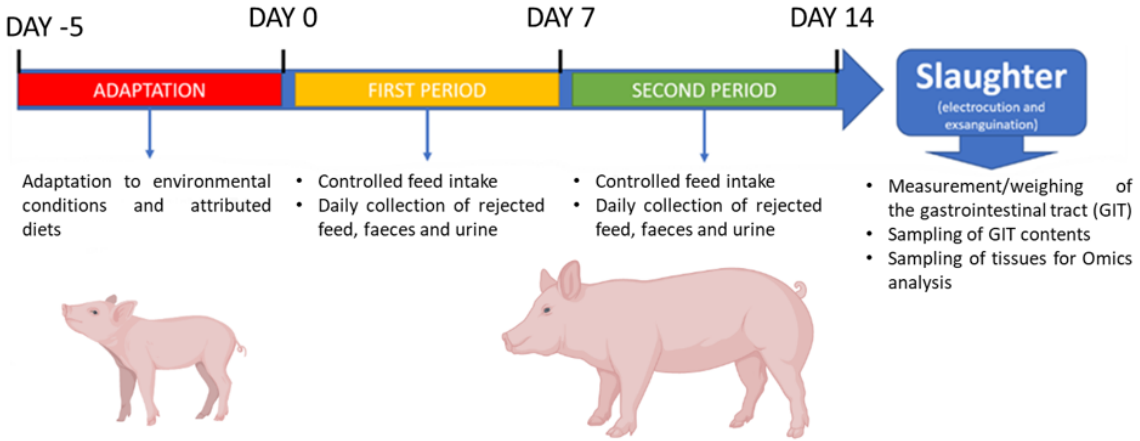
Four experimental diets:

Control – (wheat, maize soybean meal-based)

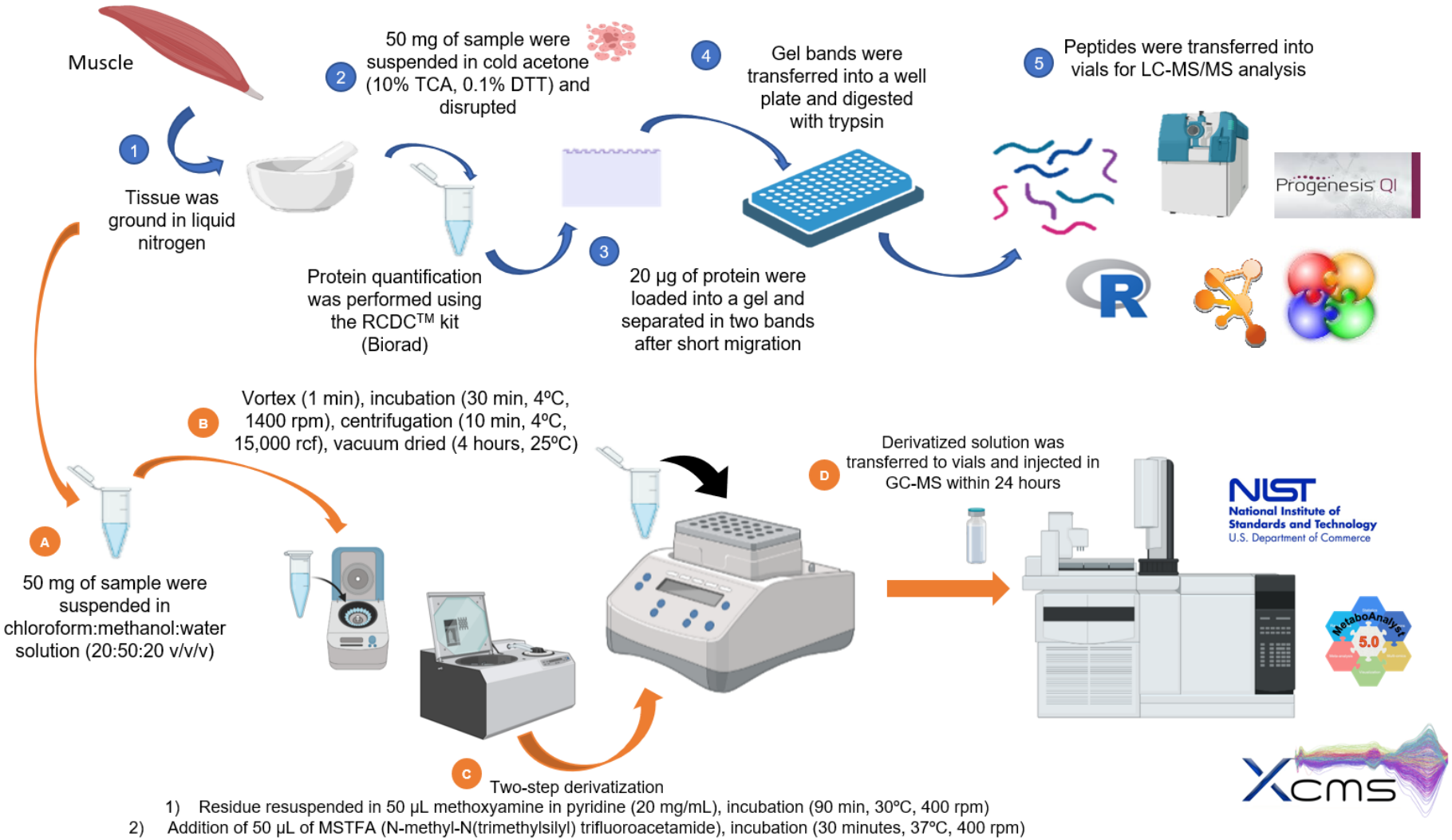
LA – 10% *Laminaria digitata* replacing control, with no added salt

LAL – LA + 0.01% alginate lyase (Costa et al., 2021)

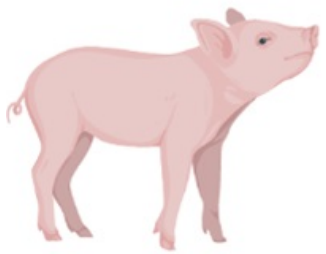
(% of DM)	Control	LA	LAL
DM	89.4	89.6	89.5
CP	18.5	17.0	17.4
CF	3.9	4.0	4.1
Ash	5.9	6.4	6.3
GE (cal/g)	4390.2	4306.1	4339.5



Omics analysis



Results: context

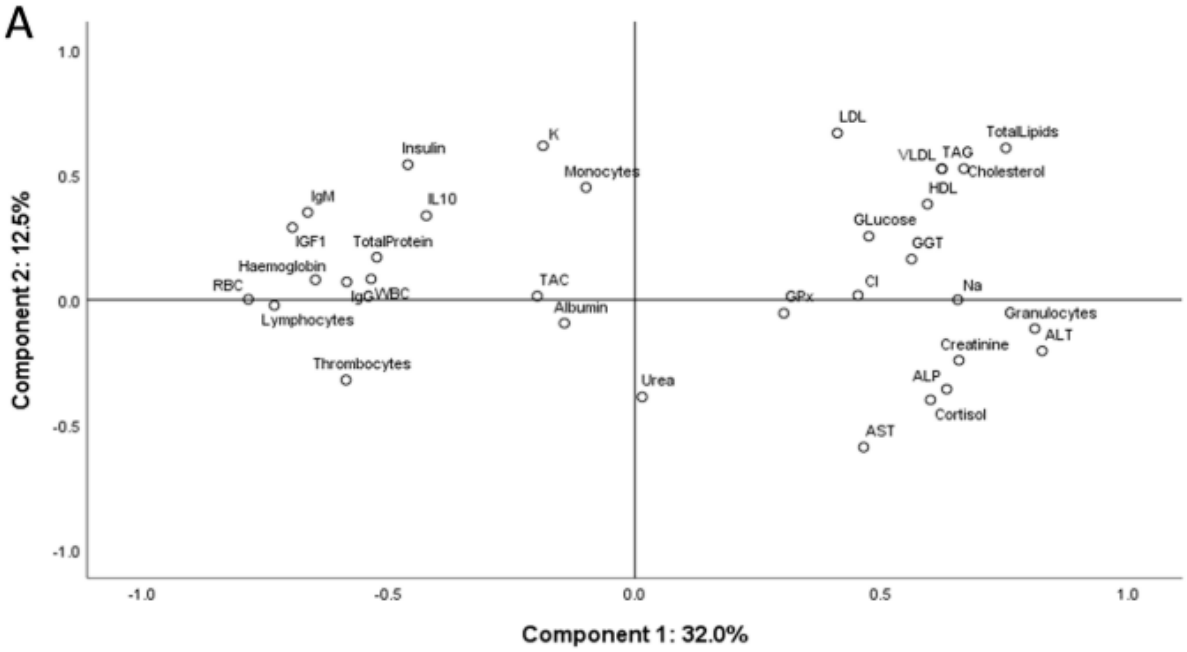


No effect on growth performance

Higher pH in LAL vs LA

Seaweed diets lowered n-6/n-3 PUFA

Seaweed diets increased Br and I



foods

MDPI

Article

Influence of Feeding Weaned Piglets with *Laminaria digitata* on the Quality and Nutritional Value of Meat

David Miguel Ribeiro [1,2,†], Cristina M. Alfaia [1,†], José M. Pestana [1], Daniela F. P. Carvalho [2], Mónica Costa [1], Cátia F. Martins [1,2], José P. C. Lemos [1], Miguel Mourato [2], Sandra Gueifão [3], Inês Delgado [3], Patrícia Carvalho [1], Diogo Coelho [1], Inês Coelho [3], João P. B. Freire [2], André M. Almeida [2] and José A. M. Prates [1,*]

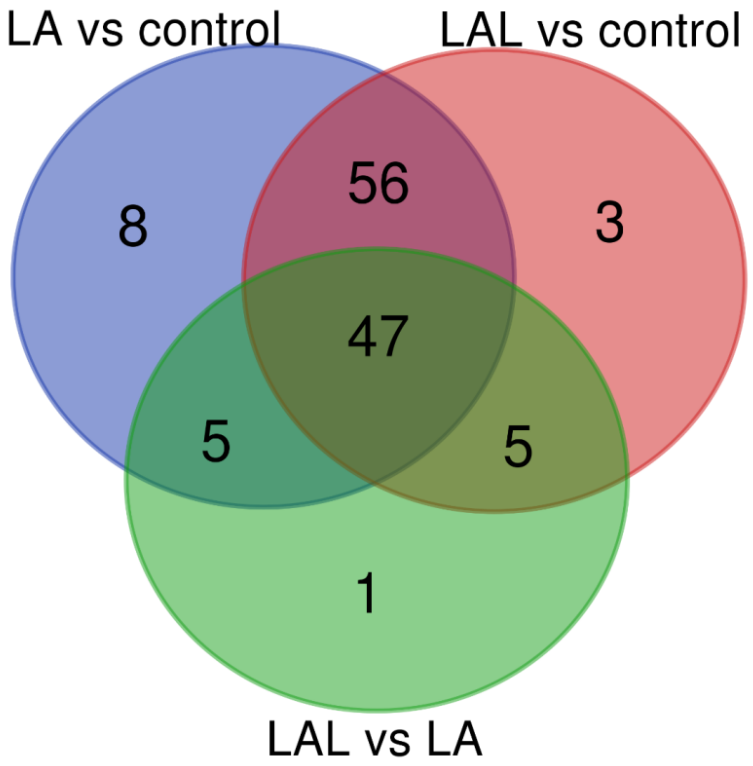
scientific reports

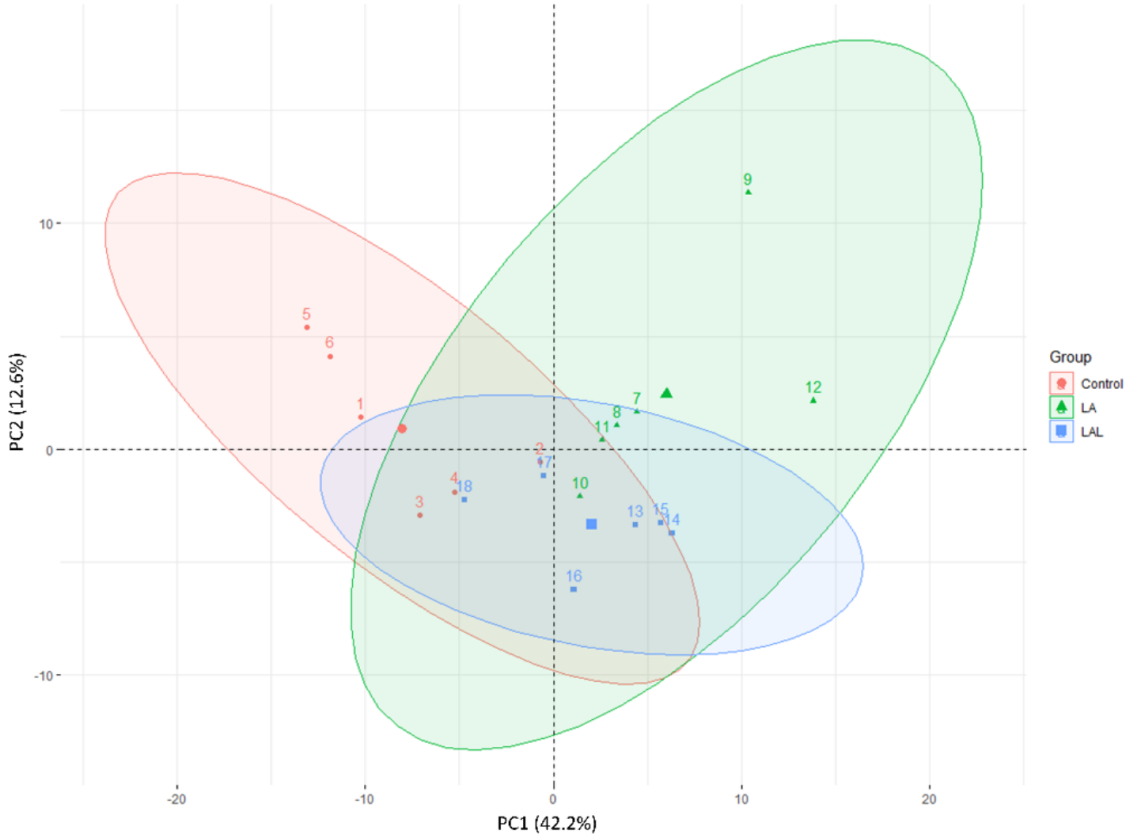
OPEN

Effect of *Laminaria digitata* dietary inclusion and CAZyme supplementation on blood cells, serum metabolites and hepatic lipids and minerals of weaned piglets

David M. Ribeiro[1,6], Rui M. A. Pinto[2,3,6], Paula A. Lopes[4,5], José M. Pestana[4,5], Cristina M. Alfaia[4,5], Mónica M. Costa[4,5], Daniela F. P. Carvalho[2], Miguel P. Mourato[2], André M. de Almeida[2], João P. B. Freire[1] & José A. M. Prates[4,5]

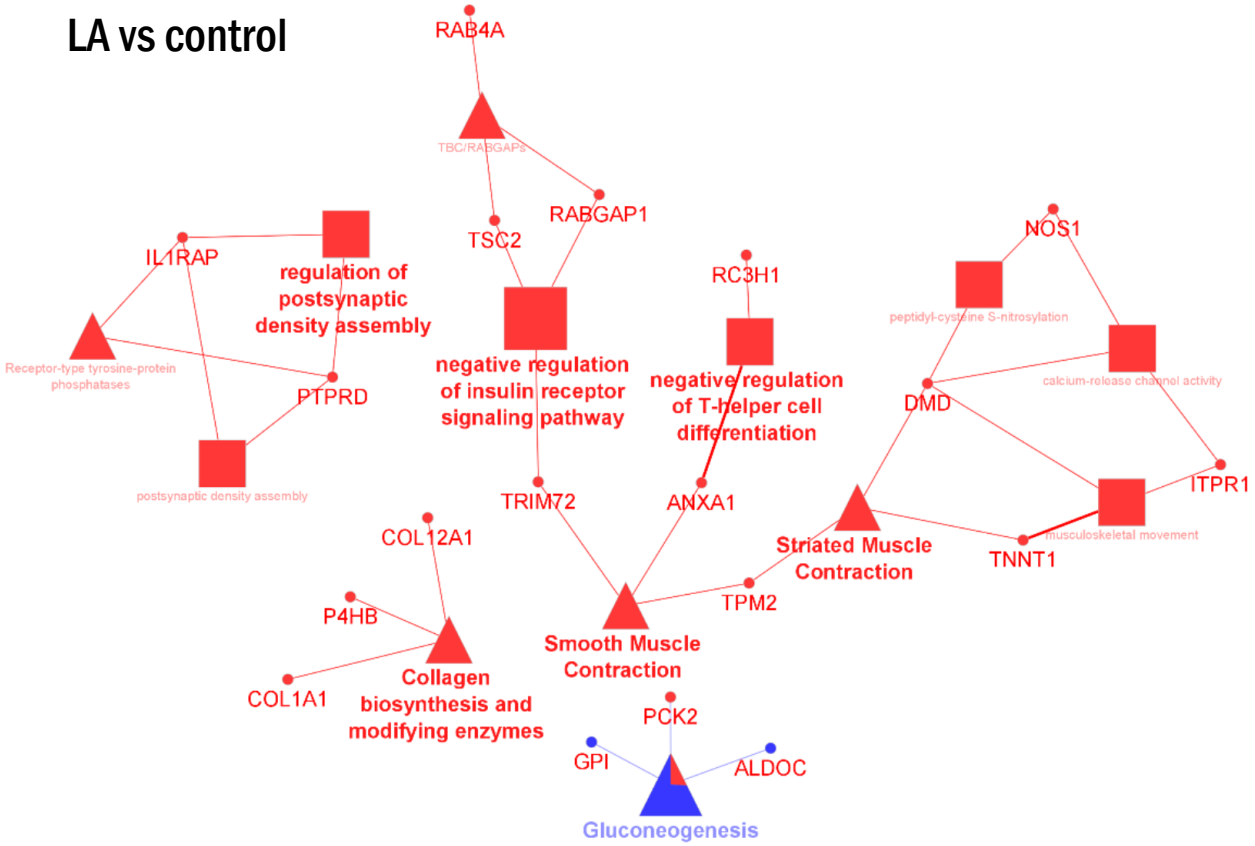
Results: proteomics



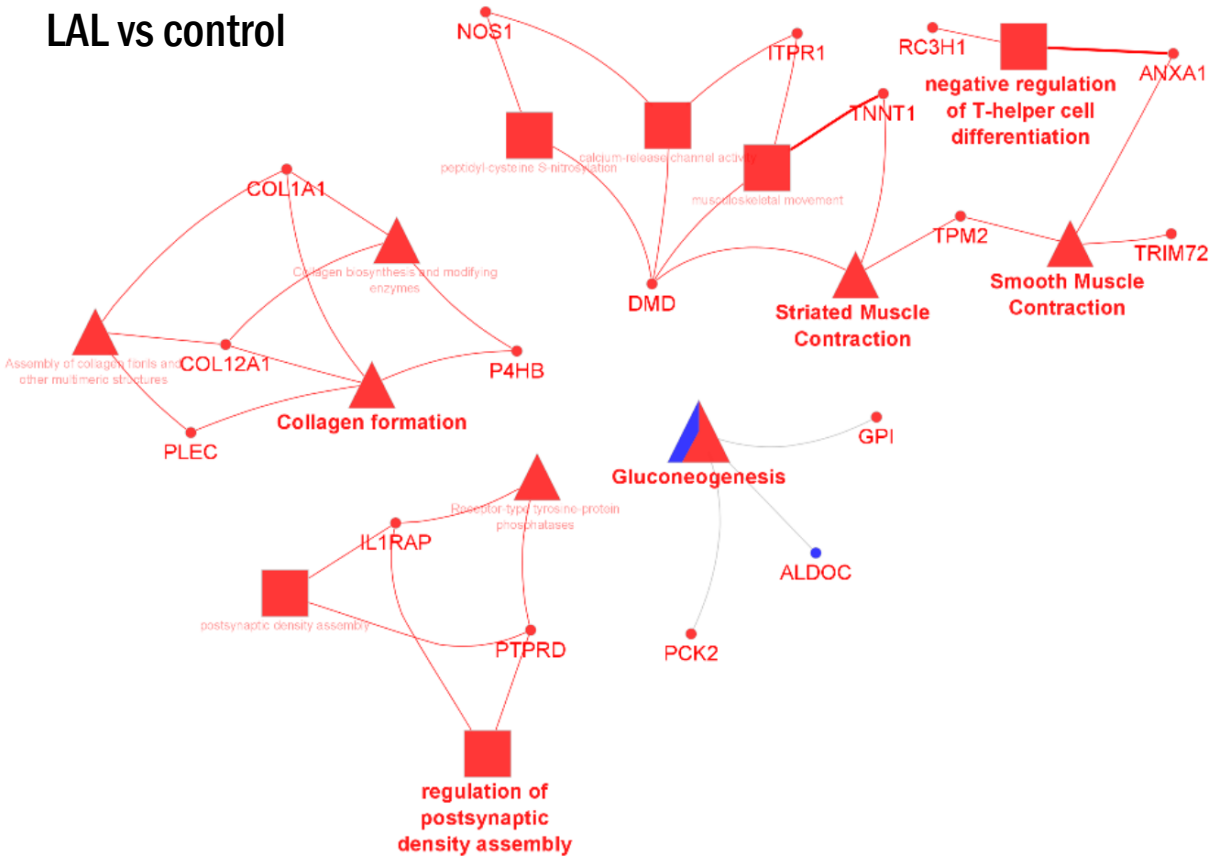


Results: proteomics

LA vs control

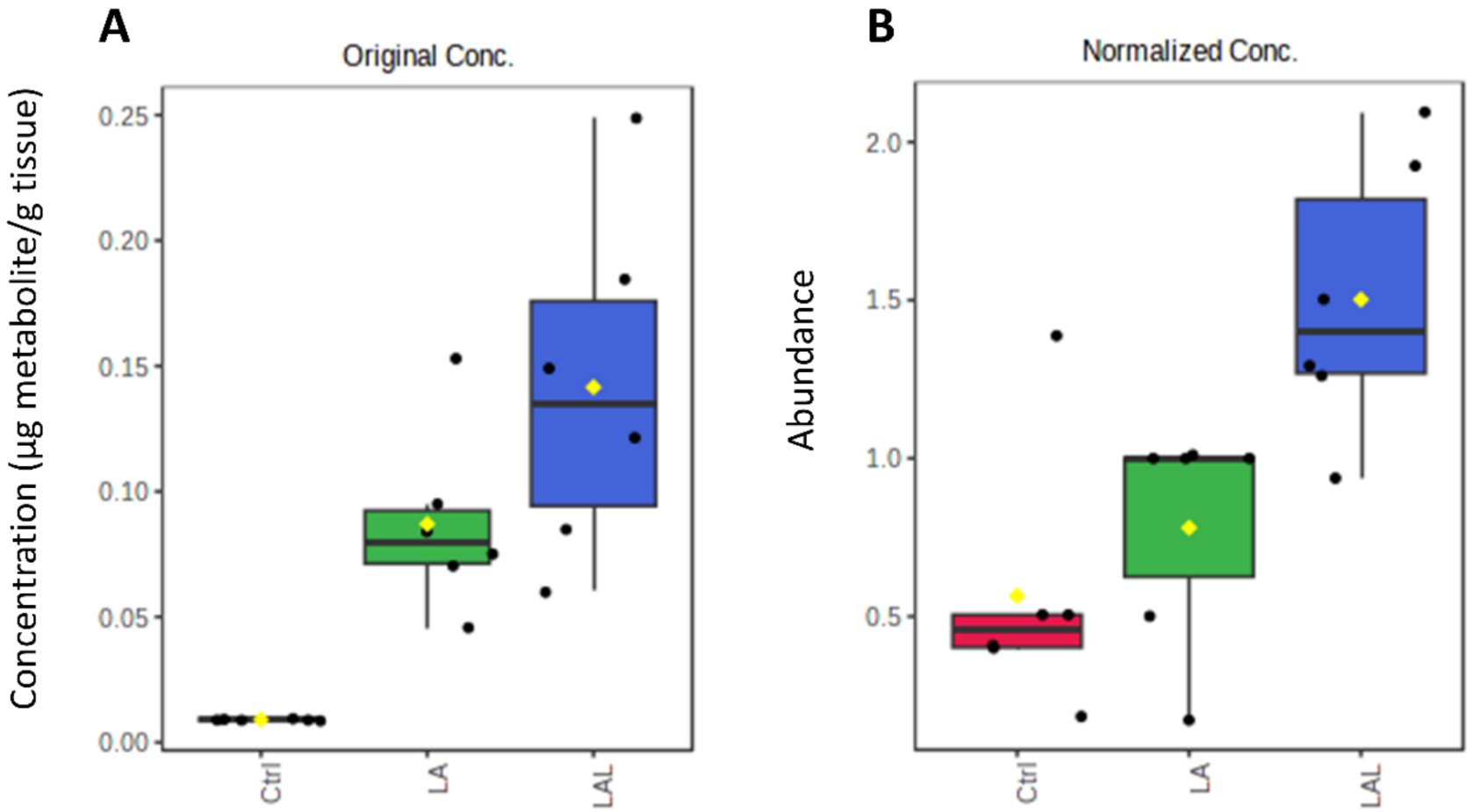


LAL vs control

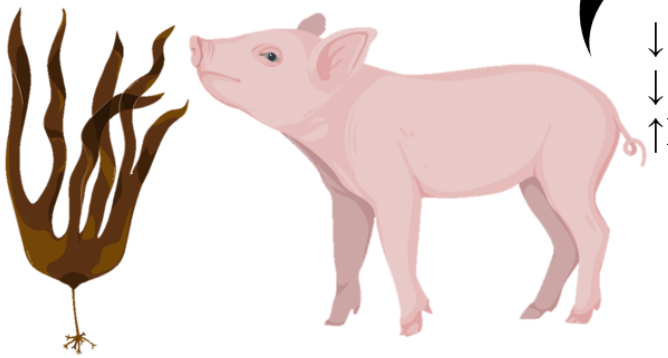


Results: Metabolomics

A- Mannitol, B-Threonine.

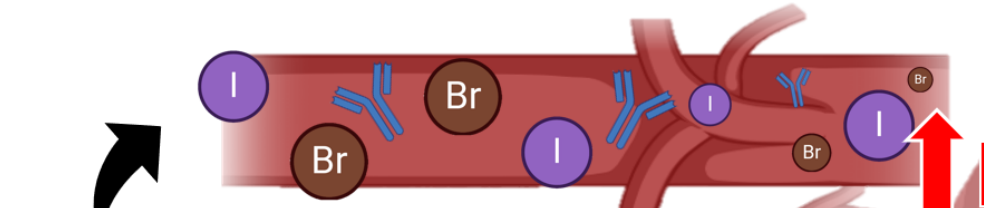


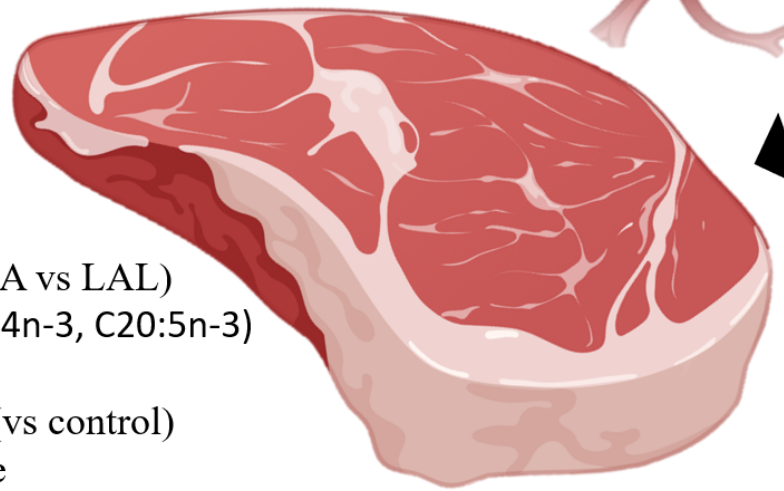
Summary



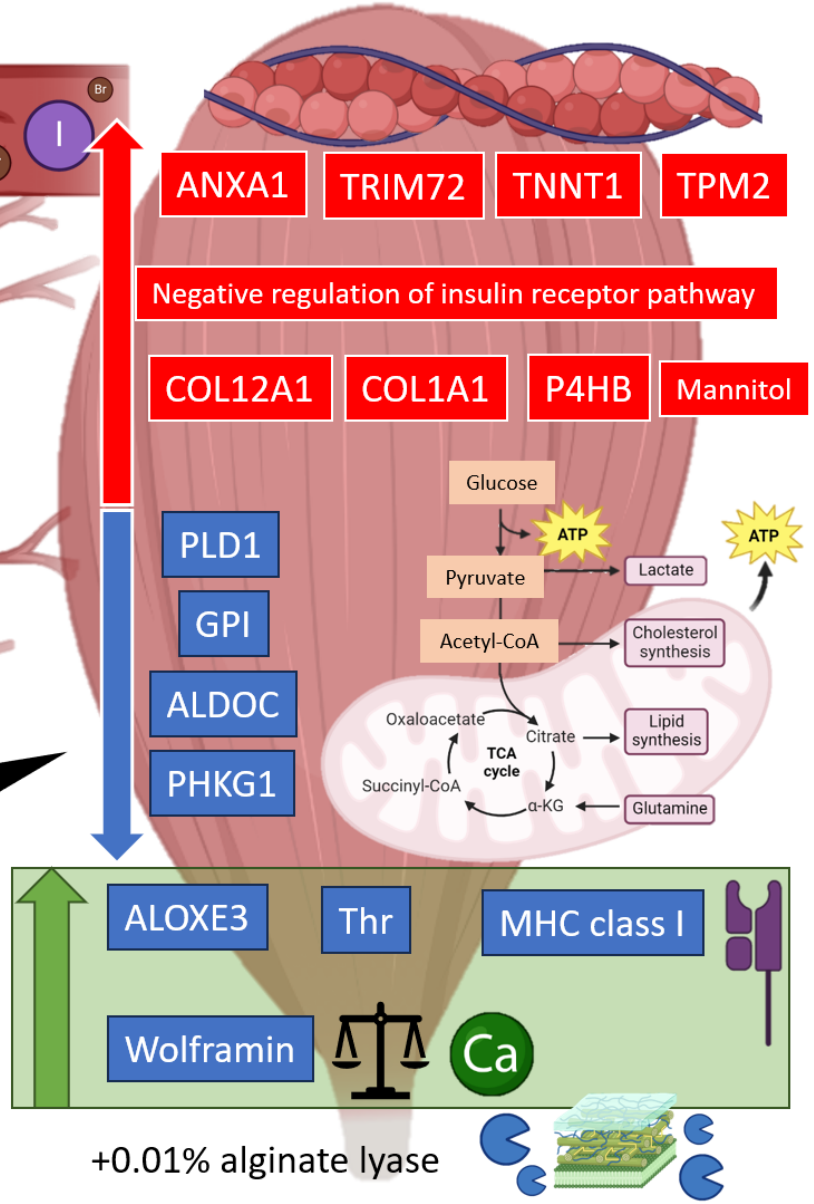
10% *Laminaria digitata*

↓ glucose (LA vs others)
↓ total lipids (LA vs control)
↑IgG, IgM





↓ meat 24h pH (LA vs LAL)
↑ n-3 PUFA (C18:4n-3, C20:5n-3)
↓ n-6/n-3
↓ lipid oxidation (vs control)
↑ Iodine, Bromine



+0.01% alginate lyase

In the future…

1. Studying the metabolism of other tissues using the same approaches would complement these results.

2. Comparing the meat vs muscle proteome could reveal if results *in vivo* translate into changes on the edible tissue.

3. Studying the effect of these diets on finishing pigs would better reflect conditions of the meat industry.

Thank you for your attention!

A huge, special **THANK YOU** to the Portuguese Society of Animal Science for making my participation in EAAP 2023 possible!

APEZ
Associação Portuguesa de Engenharia Zootécnica

Merci beaucoup!