Effects of rapeseed and palm oil on gastrointestinal nutrient sensing and appetite-regulatory mechanisms in rainbow trout

Ayelén M. Blanco[1]

Steffi Reji[2]

Emilio Vélez[2]

Jessica Calo[1]

Iban Seiliez[2]

José L. Soengas[1]

[1] Centro de Investigación Mariña, Laboratorio de Fisioloxía Animal, Departamento de Bioloxía Funcional e Ciencias da Saúde, Facultade de Bioloxía, Universidade de Vigo, Vigo, Spain

[2] Université de Pau et des Pays de l'Adour, E2S UPPA, INRAE, UMR1419 Nutrition Métabolisme et Aquaculture, Saint-Pée-sur-Nivelle, France.

E-mail:

amblanco@uvigo.gal

INTRODUCTION

The diets used to feed aquaculture fish species have historically relied on high levels of fishmeal (protein source) and fish oil (lipid source).

The continuous growth of aquaculture has led to the need to reduce the dependence on these products. Plant-derived ingredients, and specifically rapeseed oil (1,2) and palm oil (3,4), have been used as alternative lipid sources for a number of fish species.

Despite the good results for their use in aquafeeds, very little is known on the sensing mechanisms of these ingredients in the gastrointestinal tract (GIT) and on their putative role in feed intake regulation.

To characterize the putative effects of rapeseed and palm oil on the mRNA abundance of several lipid sensors and appetite-regulatory hormones in the GIT of rainbow trout (*Oncorhynchus mykiss*).

AIM

METHODS

3 dietary conditions:

- Diet rich in fish oil
- Diet rich in rapeseed oil
- Diet rich in palm oil

Sampling:

- 5 days
- 3 weeks
- 12 weeks

mRNA abundance quantification (lipid sensors and appetite-regulatory hormones)

RESULTS

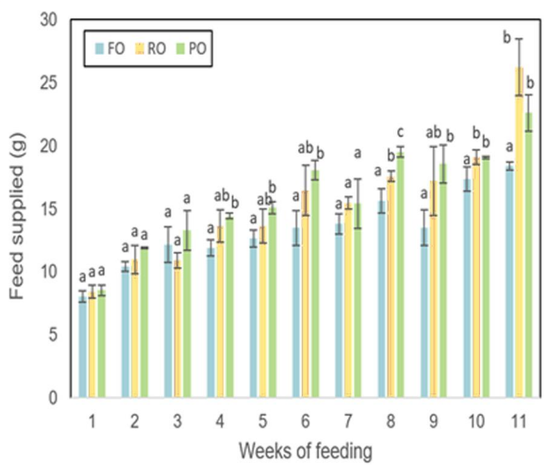

Fig 1. Amount of feed supplied to trouts during the feeding trial. Different letters denote statistical differences among diet groups within a given time point ($p<0.05$).

Ad libitum feeding with rapeseed oil- and palm oil-enriched diets required a significantly higher amount of feed to reach fish satiety (**Fig. 1**), which indirectly suggests increased feed intake levels compared to fish fed a high fish oil diet, especially during the last weeks of the trial.

Fish fed with vegetable diets showed significantly higher plasma triglyceride and fatty acid levels (**Fig. 2**).

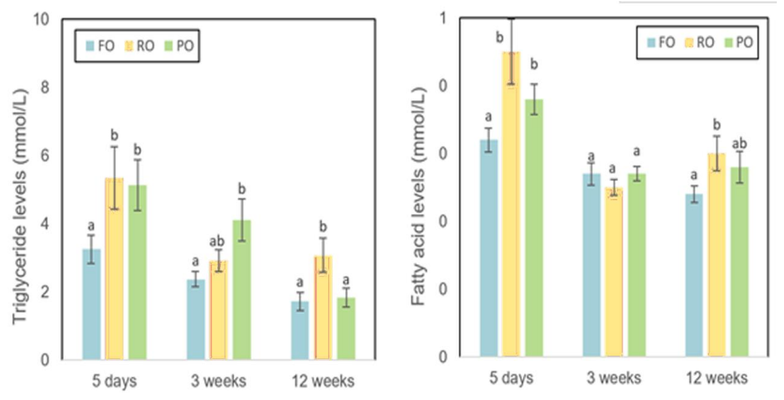

Fig 2. Plasma triglyceride and fatty acid levels in trout fed a diet rich in fish (FO), rapeseed (RO) or palm (PO) oil. Different letters denote statistical differences among diets within a given time point ($p<0.05$).

Changes in the mRNA abundance of gut lipid sensors in response to rapeseed and palm oil were more notorious in the distal intestine, where increased levels of mRNAs encoding the fatty acid transporter Cd36, free fatty acid receptor 1 (Ffar1), members of the Ffar2 family, and the G-protein coupled receptor 119 (Gpr119) were observed compared to fish fed a high fish oil diet (**Table 1**).

	Prox. Int.		Distal Int.	
	RO	PO	RO	PO
cd36	▲	≈	▲	▲
fatp4	≈	≈	▼	▼
ffar1	≈	≈	▲	▲
ffar2-family	≈	≈	▲	▲
gpr84	≈	≈	nd	nd
gpr119	≈	≈	▲	▲
cck	▲/▼	≈/▼	▲/▼	▲/▼
pyy	≈	≈	nd	nd
glp-1	≈	≈	▲/≈	▲/≈

Table 1. Differences (▲, increase; ▼, decrease; ≈, none) in mRNA levels of lipid sensors and appetite-regulatory hormones in proximal and distal intestine of fish fed rapeseed oil- (RO) or palm oil- (PO) enriched diet compared to control (fish oil) fish. nd: not detected. *cck*, colecistokinin; *cd36*, fatty acid transporter Cd36; fatp4, fatty acid transport protein 4; ffar, free fatty acid receptor; *glp-1*, glucagon-like peptide; *gpr*, G protein-coupled receptor; pyy, peptide tyrosine-tyrosine.

Interestingly, rapeseed oil- or palm oil-evoked changes in the mRNA abundance of gastrointestinal appetite-regulatory hormones (colecistokinin -*cck*-, peptide tyrosine tyrosine -*pyy*-, and glucagon- like peptide 1 -*glp1*-) showed an increase during the first weeks of trial (suggesting anorexigenic potential) but a decrease during the last weeks (suggesting orexigenic potential, as in Fig. 1) (**Table 1**).

Results from this research offer a view of physiological appetite-regulatory mechanisms activated upon feeding vegetable diets, which can serve for better and more efficient aquafeed formulations.

References

1. Adem *et al. OCL* 2014; 21: D105.
2. Perera Willora *et al. Aquac Rep*. 2021; 19: 100560.
3. Larbi Ayisi. *Int J Sci Technol Res*. 2014; 3: 259-264.
4. Bahurmiz and Ng. *Aquaculture*. 2007; 262: 382-392.

Acknowledgements: This research was funded by Spanish Agencia Estatal de Investigación and European Fund of Regional Development, Xunta de Galicia and HORIZON2020 (AQUAEXCEL3.0).