Date seed meal as sustainable aquafeed ingredient. Potential use in juvenile mullets.

S. Ramírez-Bolaños[1], B. Pontón-Segura[1], C. Pérez-Hernández[1] I. Florido[1], F. Moyano[2], R. Quirós-Pozo[1], P. Castro[1], L. Robaina[1*].

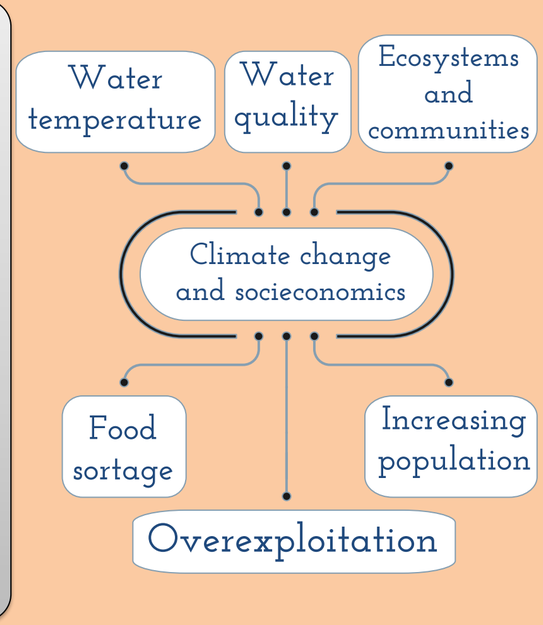
[1]Grupo de Investigación en Acuicultura (GIA), IU-ECOAQUA, Universidad de Las Palmas de Gran Canaria, Crta. Taliarte s/n, Telde 35214, SPAIN

[2] Departamento de Biología y Geología, Facultad de Ciencias, Campus de Excelencia Internacional del Mar (CEI-MAR), Universidad de Almería, 04120 Almería, SPAIN

E-mail: lidia.robaina@ulpgc.es

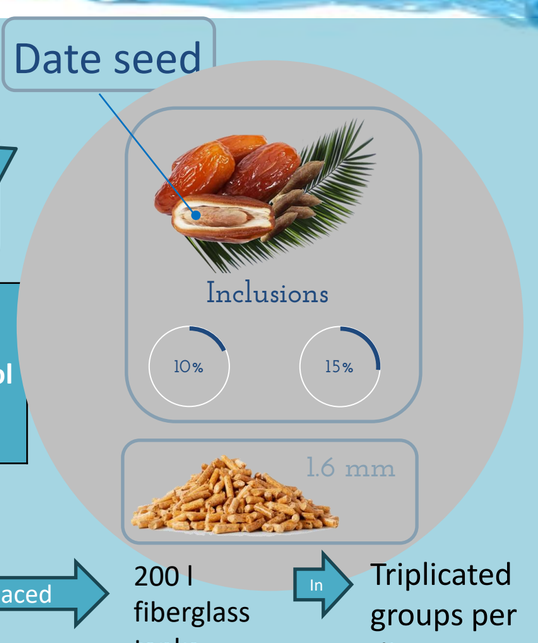
Aquaculture importance in the last years has reached its maximum point and there are many overexploited natural resources. Furthermore, the ambiental question is more alarming due to climatic change and human contamination, and the population is growing as the fish protein needs in its diets. So, it requires a sustainable aquafood demand. If aquafood demand increases, fish meal demand (and feed ingredients from plants) will increase too. That is, it is considerable to use novel ingredients and keep investigating in aquaculture.

The market competition with the same fish species may position the different producers and countries under different competition levels, directly affecting business sustainability for the time being. So, it is necessary to work on new fish species. *The Mugilidae* family is interesting because of its characteristics. There are not many studies about *Liza aurata's* nutritional aspects, but there is a recommended protein level of about 25-30%. Studies with vegetable by-products in diets are few. However, there are some of them with, for example, *Aloe Vera.*



Date seed is a growing interest ingredient in aquaculture because It has a high monosaturated fatty acids concentration, mainly oleic acid, and it is a good source of lipid-soluble antioxidant compounds like phenols, tocopherols, and phytosterols. Also, this fruit contains bioactive compounds, even insoluble fibres, which may benefit the fish's health and well-being.

Experimental diets

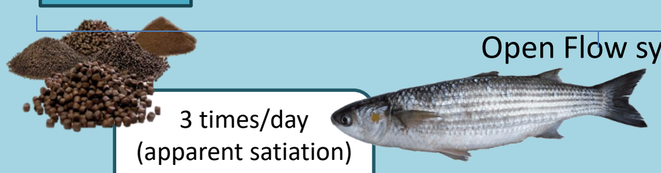


Untreated seeds: Raw Date Seed (RDS)
Treated seeds: Microwave Raw Date Seed (MRDS) (8 minutes at 600W)

RDS		MRDS		Control
10RDS	15RDS	10MRDS	15MRDS	

50 fish/tank → 5±0.33 g initial weight → Placed → 200 l fiberglass tanks → In → Triplicated groups per diet

Open Flow system



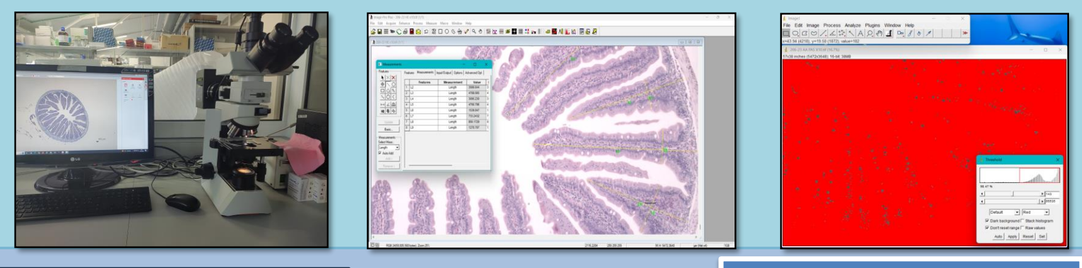
3 times/day (apparent satiation) six days a week

- ✓ Moisture
- ✓ Ash
- ✓ Protein
- ✓ Lipids
- ✓ Fatty acids

Livers → Microscopic analysis

- Membrane
- Lipids
- Glycogen
- Vascularization
- Nucleus
- Pyknosis
- Pyknosis

Intestines → Micrograph analysis → Measurements → ANOVA



Liver Biochemistry

Table 1 *Composition of the liver (dry weight) after feeding the experimental diets. Values in same row with different letter denote significant differences P≤0.05*

	Diet				
	CONTROL	**10 RDS**	**10 MRDS**	**15 RDS**	**15 MRDS**
Lipid	32.19 ± 6.54^{ab}	27.29 ± 4.34^{ab}	32.30 ± 4.43^{a}	32.33 ± 5.60^{a}	23.88 ± 5.39^{b}
Moisture	65.20 ± 0.99^{c}	69.07 ± 0.48^{ab}	70.22 ± 1.37^{a}	70.04 ± 2.02^{ab}	68.62 ± 0.74^{b}

Highest lipid values

2 different strategies

- 10 MRDS → Mobilizes lipids for growing
- 15 RDS → Stores to mobilize

(Schloesser et Fabrizio *et al.*, 2017)

Whole body

Table 2 *Whole fish fatty acids content after feeding the experimental diets*

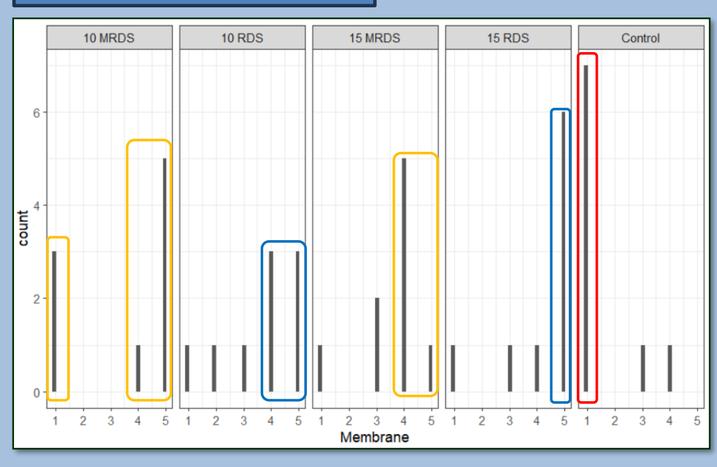
		Diet				
		CONTROL	**10 RDS**	**10 MRDS**	**15 RDS**	**15 MRDS**
LN	**18:2n-6**	18.83 ± 0.27^{ab}	20.59 ± 0.28^{a}	20.18 ± 0.97^{ab}	18.53 ± 0.52^{ab}	18.27 ± 1.42^{b}
LNA	**18:3n-3**	14.91 ± 0.23^{a}	14.18 ± 0.14^{ab}	15.39 ± 0.48^{a}	12.46 ± 0.67^{b}	12.90 ± 1.28^{b}
ARA	**20:4n-6**	0.40 ± 0.02	0.40 ± 0.02	0.40 ± 0.03	0.45 ± 0.04	0.43 ± 0.05
EPA	**20:5n-3**	2.43 ± 0.21	2.31 ± 0.15	2.26 ± 0.20	2.41 ± 0.23	2.56 ± 0.40
DHA	**22:6n-3**	4.92 ± 0.35	4.62 ± 0.45	4.63 ± 0.45	4.97 ± 0.42	5.41 ± 0.91

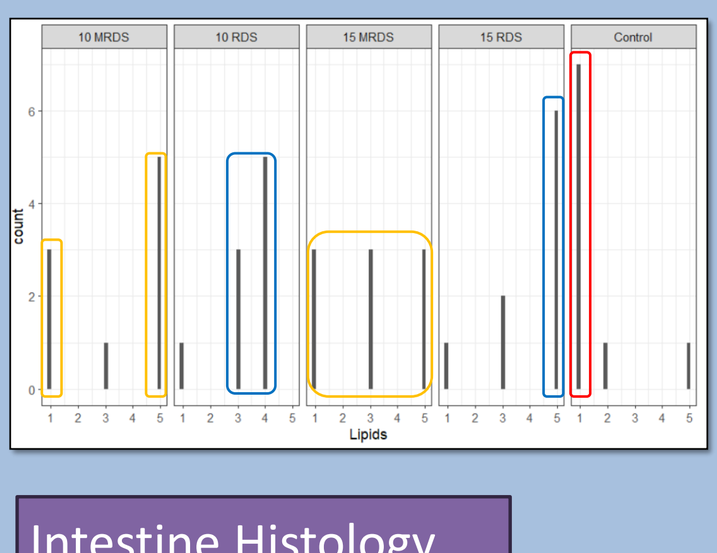
↓ Values

↑ Values

(Tocher *et al.*, 2015) one of mullets characterise is biosynthesize LC-PUFA from C18 precursor

Liver Histology





Membrane definition

Numeric scale:
"1": higher visibility and definition.
"2", "3", "4": decreasing definition
"5": unable to identify the cell membrane

Control: well-defined membranes

RDS diets: bad defined membranes

MRDS diets: 10MRDS have high defined membranes in some samples

Lipid content

Numeric scale:
"1": higher content
"2", "3", "4": lower content
"5": absence of lipid content or unable to detect lipids

Control: elevated content

RDS diets: lower content respect to glycogen and overall

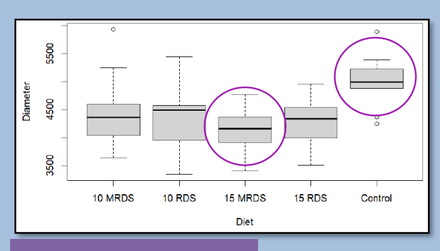
MRDS diets: some 10MRDS simples shows high content; 15MRDS shows a broad range on contents

Intestine Histology

Less surface area → Worst nutrient absorption

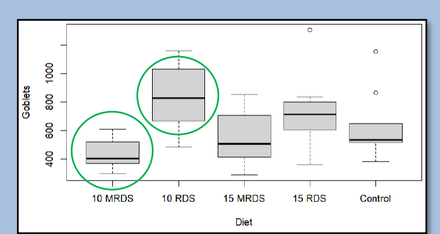
Less goblet cells → Unfavorable intestinal condition

(Wang *et al.*, 2017)
(Alesci *et al.*, 2022)



Diameter ANOVA representation

Histological section of intestine corresponding to the 10MRDS diet.



ANOVA representation of the goblet cell content.

Histological section of intestine corresponding to the 10RDS diet.

10 MRDS

- Fish have grown
- Fish have accumulated little fat
- Similar profile of n-3 HUFA than control

Fish that grows in a ✓ condition with less fat

Experimental diets vs control

Liver

- Worst than control diet.
- More inclusion tends to be worst

Intestine

- Similar results overall
- 15MRDS leds to worst nutrient absortion
- 10MRDS leds unfavorable intestinal condition

ULPGC Universidad de Las Palmas de Gran Canaria

ADVANCED ISLANDAP Aquaponics & Circular Economy on islands

ECOAQUA www.ecoaqua.eu