RHEOLOGICAL PROPERTIES ASSESSMENT OF CARP FEED MIXTURES WITH DIFFERENT PROTEIN SOURCES USING MIXOLAB

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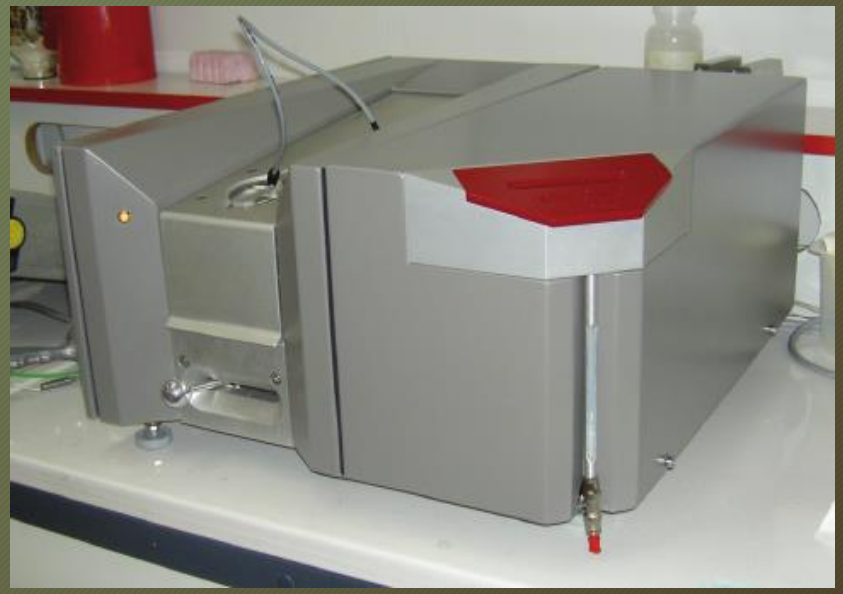
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Aim of the investigation

- Evaluating the thermo-mechanical and water absorption properties of three fish feed mixtures with identical starch content and particle size, but differing protein sources.
- Assesing the changes in starch granules and predicting the behaviour of the resulting paste and its impact on subsequent fish diets processing steps.







The IMPRESS Vision

- The significant enhancement of the marine and freshwater bio-based economy in Europe by harnessing underutilized low trophic species (LTS).





IMPRESS

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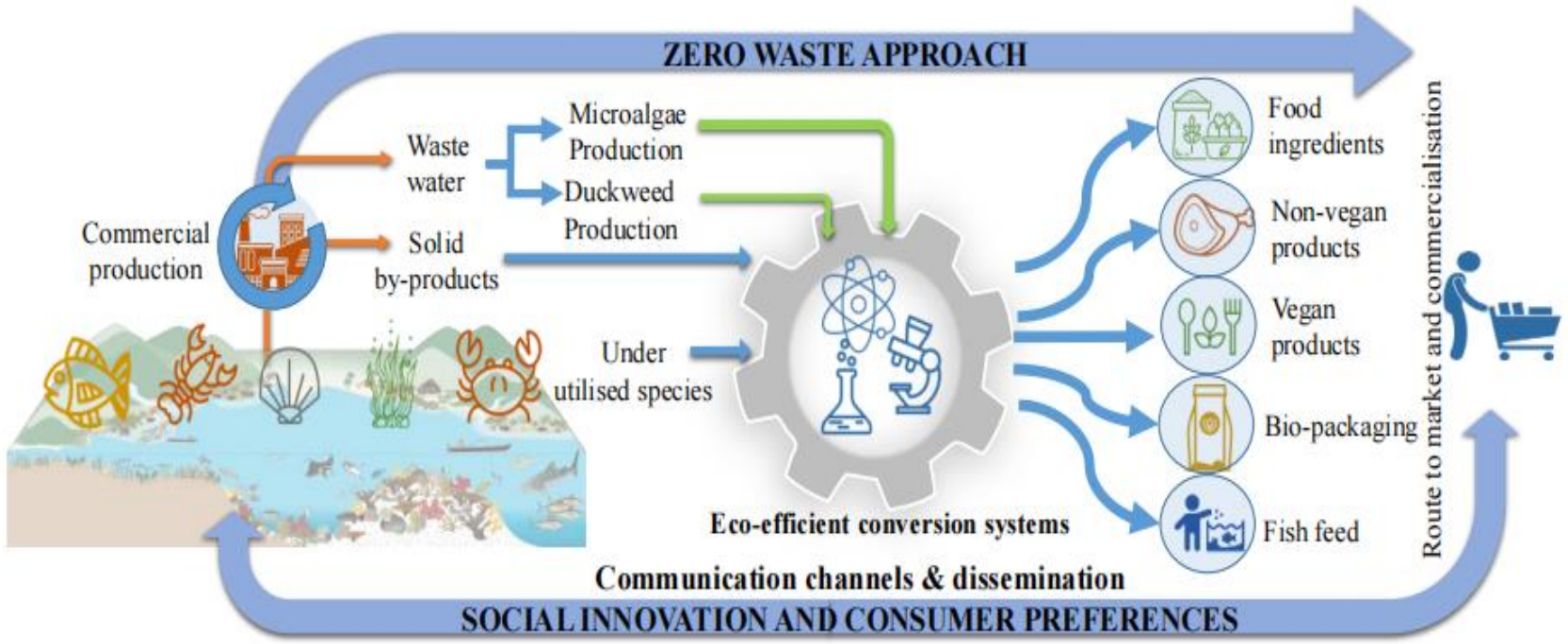
European Commission | HORIZON EUROPE 2021-2027

The IMPRESS Mission

- The IMPRESS mission supports the EU's commitment to address economic, environmental, and societal challenges while fostering fair, healthy, and environmental-friendly food systems and consumer goods from production to end products.

The IMPRESS Objectives

- The main goal – the development and promotion of new products and processes from freshwater and marine resources.



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Duckweed (water lenses or water lentils)

Duckweed is gaining attention as a sustainable ingredient in fish feed. It offers several benefits:



1. Nutritional value
2. Rapid growth
3. Sustainability
4. Cost-effective
5. Environmental benefits
6. Novel food.

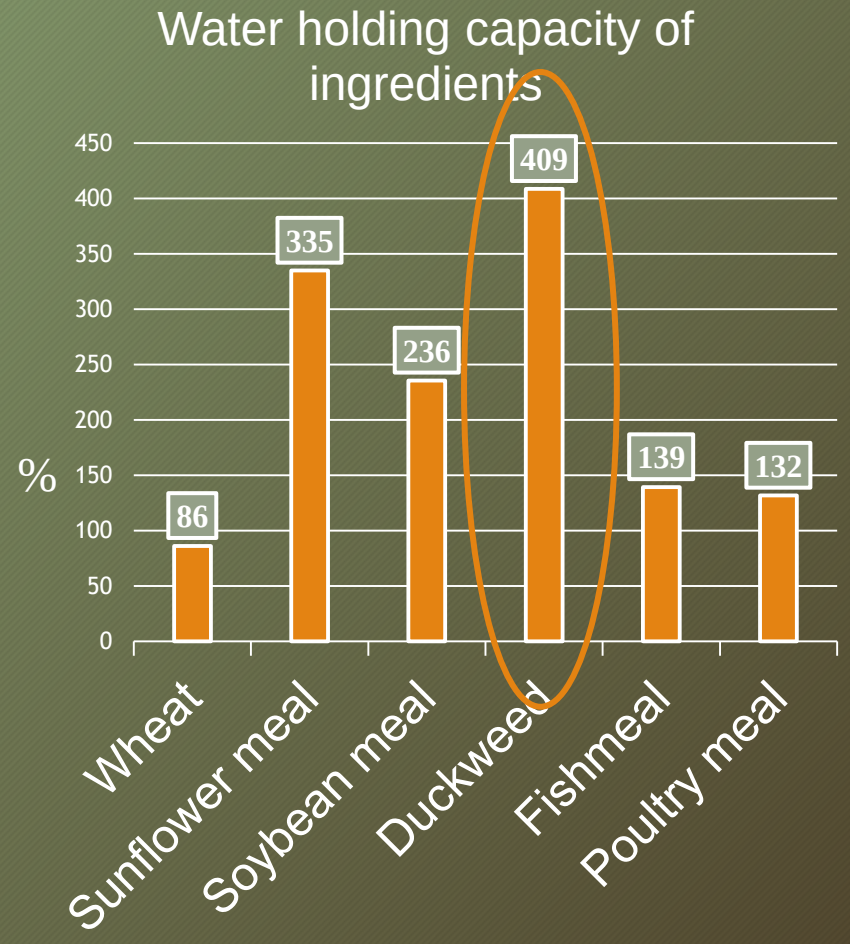
Using duckweed in fish feed presents a promising alternative for enhancing aquaculture sustainability.

Duckweed (*Lemnacea*) flour



- Fine, free flowing green powder
- Non-GM
- Antinutritional-free

Analyzed composition (g/kg)	Fish meal	Duckweed	Soybean meal
Dry matter		940.0	884.7
Crude protein	710.0	331.4	431.2
Crude fat	100.0	52.7	9.1
Crude fiber	2.0	28.2	68.5
Crude ash	110.9	56.4	65.4
Lysine	63.8	24.3	22.3
Methionine	28.8	9.0	2.1
Threonine	33.0	16.0	16.9



Diet formulations

Diets	Control	Diet 1	Diet 2
Formulation (g/kg)			
Wheat	320.0	320.0	320.0
Sunflower meal	235.0	235.0	235.0
Fishmeal	200.0	0.0	200.0
Soybean meal	100.0	100.0	0.0
Duckweed	0.0	200.0	100.0
Poultry meal	80.0	80.0	80.0
Rapeseed oil	35.0	35.0	35.0
$CaCO_3$	30.0	30.0	30.0
Analyzed composition (g/kg)			
Crude protein	358.7	275.6	348.4
Crude fat	67.9	58.3	73.7
Crude fiber	60.6	61.4	62.2
Crude ash	95.1	77.7	94.2
Starch	229.5	229.9	229.1



Ingredients

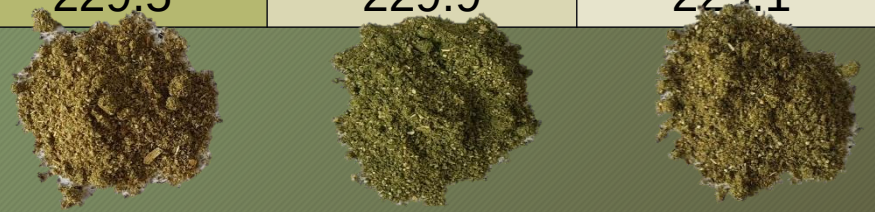
Grinding



Mixing



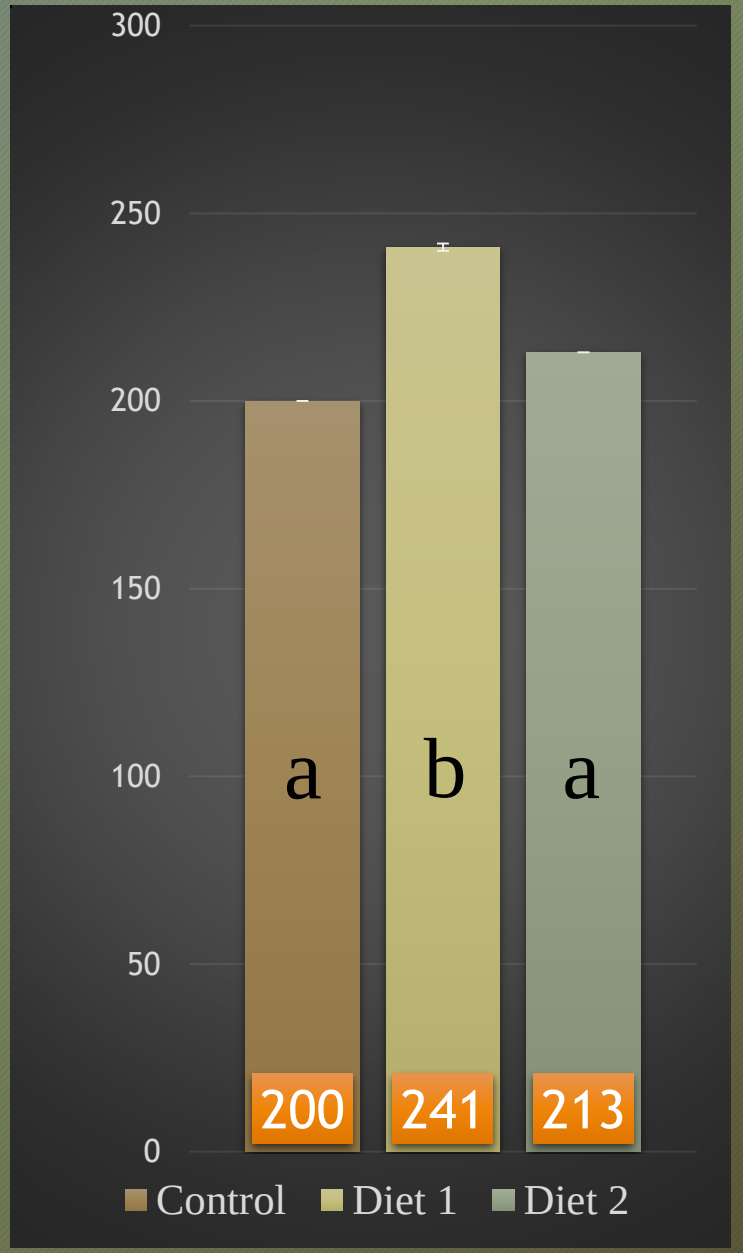
Diets



Water holding capacity

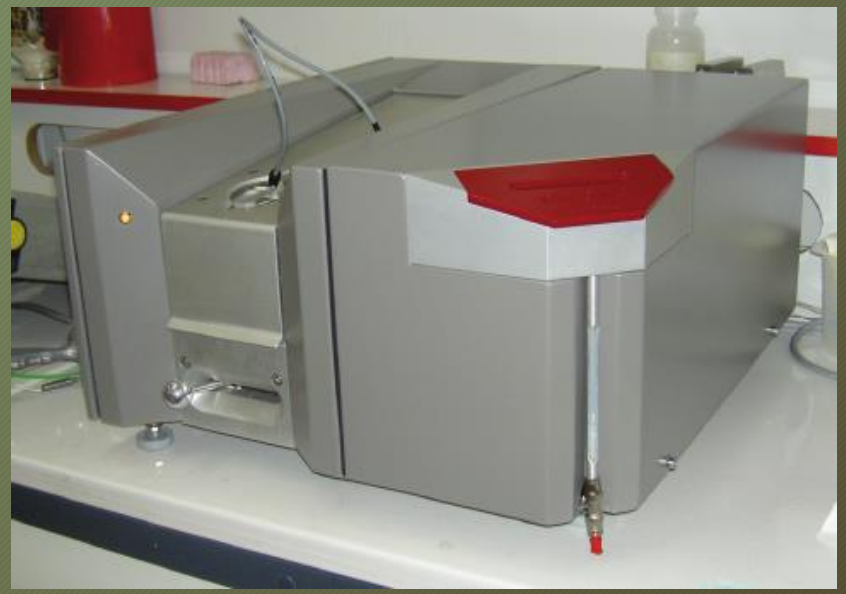




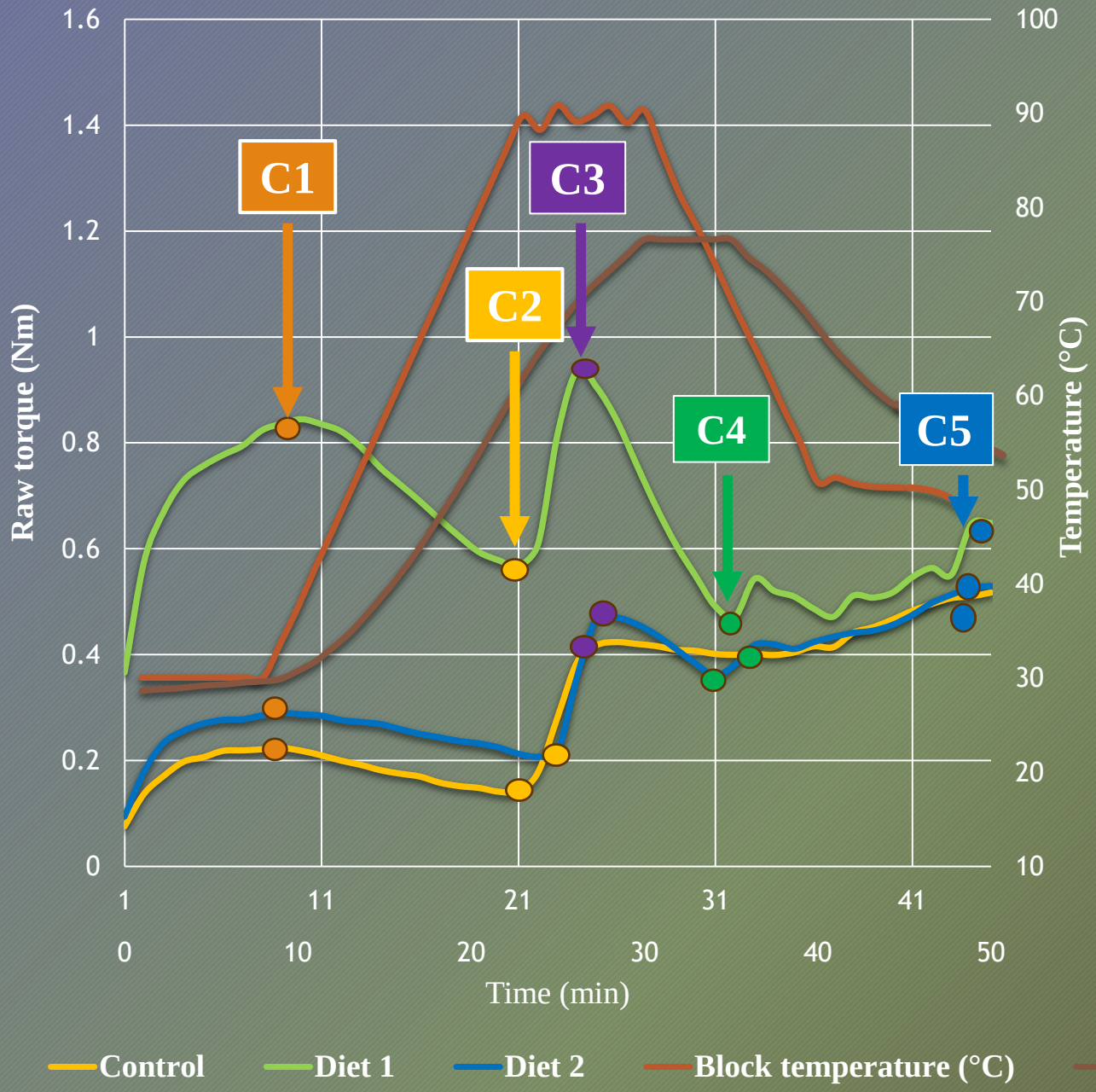


Mixolab protocol – ovo namestiti da bude u tackama kako je isao protokol

- Temperature regime was set at 30 °C for the first 8 min and then heated to 90°C over 15 min at the rate of 4 °C/min. Samples were held at 90 °C for 7 min and then cooled to 50°C over 10 min at the rate of 4 °C/min and finally held at 50°C for 5 min.



Results



Hydration % (14% base)			
Parameter	**Control**	**Diet 1**	**Diet 2**
Water absorption (%)	100	100	100
Moisture content (%)	6.25	6.50	6.90
Maximum torque during mixing - C1 (Nm)	0.22[a]	0.85[b]	0.39[a]
Dough development time (min)	10.36[a]	10.20[a]	9.83[a]
Minimum consistency - C2 (Nm)	0.14[a]	0.56[b]	0.26[a]
TC2 (min)	21.58[a]	20.91[a]	27.19[a]
Peak torque - C3 (Nm)	0.42[a]	0.94[b]	0.46[c]
TC3 (min)	26.19[a]	23.99[b]	25.15[c]
Minimum torque - C4 (Nm)	0.40[ab]	0.44[b]	0.35[a]
TC4 (min)	33.27[a]	31.93[a]	32.15[a]
Final torque - C5 (Nm)	0.52[a]	0.65[b]	0.53[a]
TC5 (min)	45.02	45.02	45.02
Setback torque - C5-C4 (Nm)	0.12[a]	0.21[b]	0.18[b]
Breakdown torque - C3-C4 (Nm)	0.02[a]	0.45[b]	0.11[c]
Attenuation rate of protein in warming - C1-C2 (Nm)	0.08[a]	0.29[b]	0.13[c]

Conclusion

- These are the preliminary results.
- Further investigation is needed for establishing production parameters related to the moisture content of feed mixes that undergo the extrusion process.
- Also, it is necessary to do detailed characterization of functional properties of duckweed.
- Complete replacement of fishmeal with duckweed is potentially technologically impractical, but from the nutritional standpoint achievable.

