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a ochrany vod
Faculty of Fisheries
and Protection
of Waters

Jihočeská univerzita
v Českých Budějovicích
University of South Bohemia
in České Budějovice

CENAKVA

South Bohemian Research Center
of Aquaculture and Biodiversity
of Hydrocenoses

Aquaculture and circular bioeconomy

Balanced & Circular pond feeds in Central European fishponds

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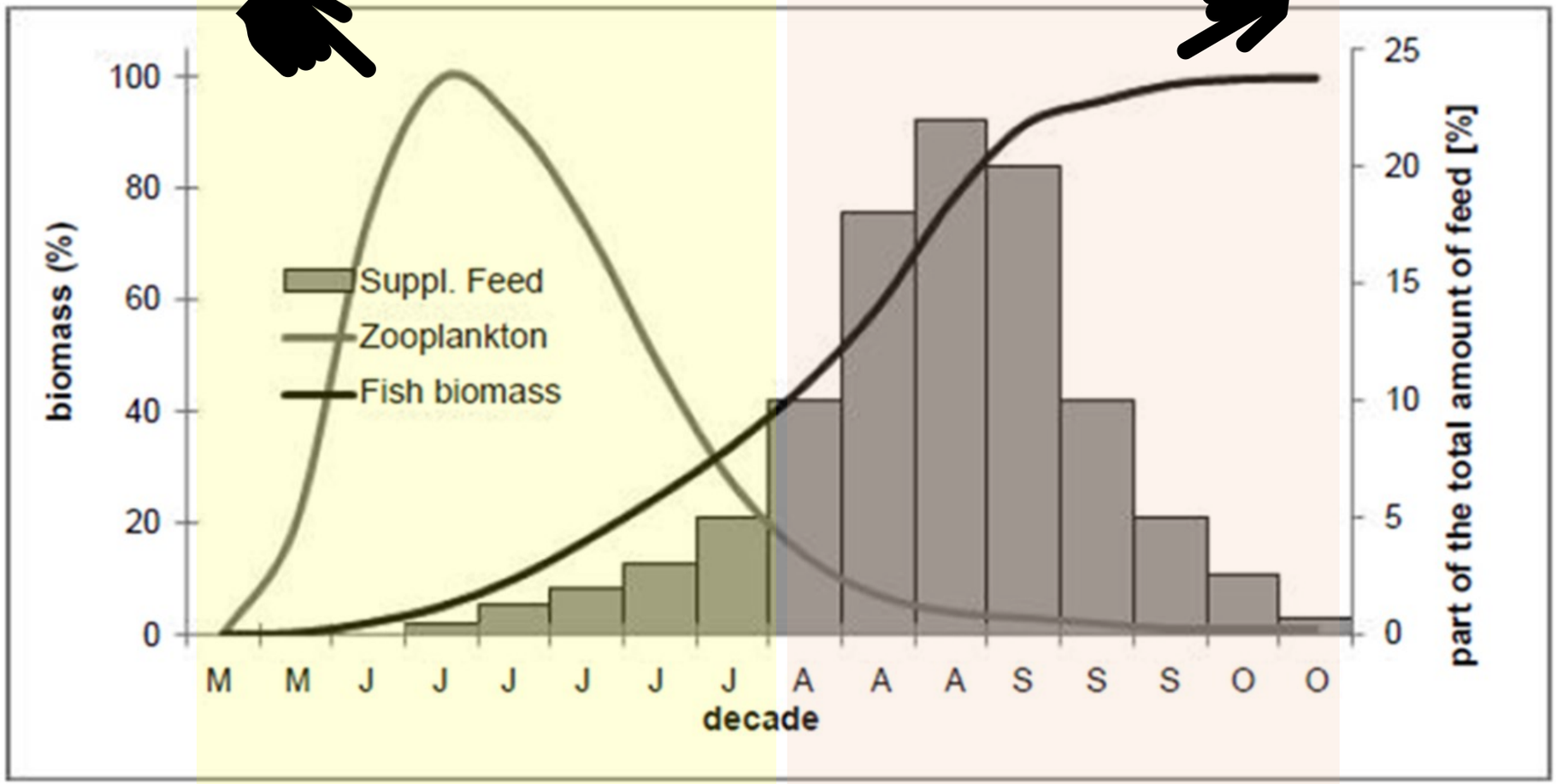
Lab Deputy – Fish Nutrition working group

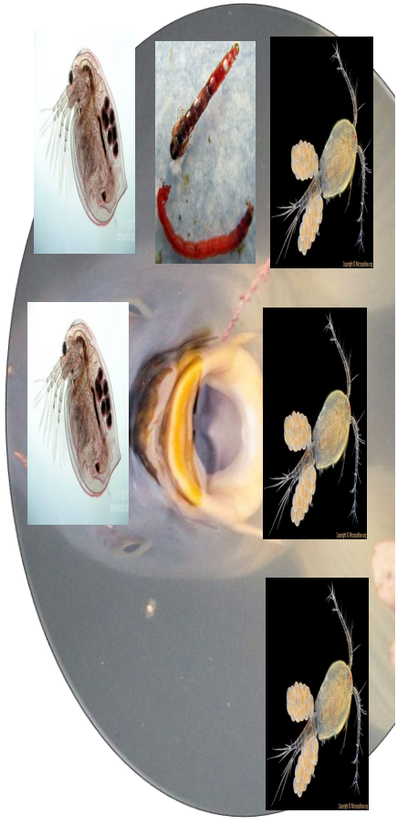
Balanced pond feeding concept

Supply NPE and fibers here

Supply amino acids (protein), and NPE here



https://doi.org/10.1016/j.jclepro.2022.132584



Carps start on a “keto” diet

Starch + SFA + MUFA >> NDF

..have a balanced diet in between – shortly ☹

NDF + ADF + high bioavailable P

And ends up with a starchy one!

Gluten

Globulin

Legumin

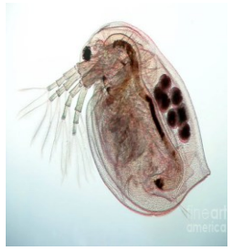
Model concept

Pond feed/ farm-made feed/ feed mixtures made up of local, circular resources.

https://doi.org/10.1016/j.jclepro.2022.132584

LOCAL PROTEIN FEEDS

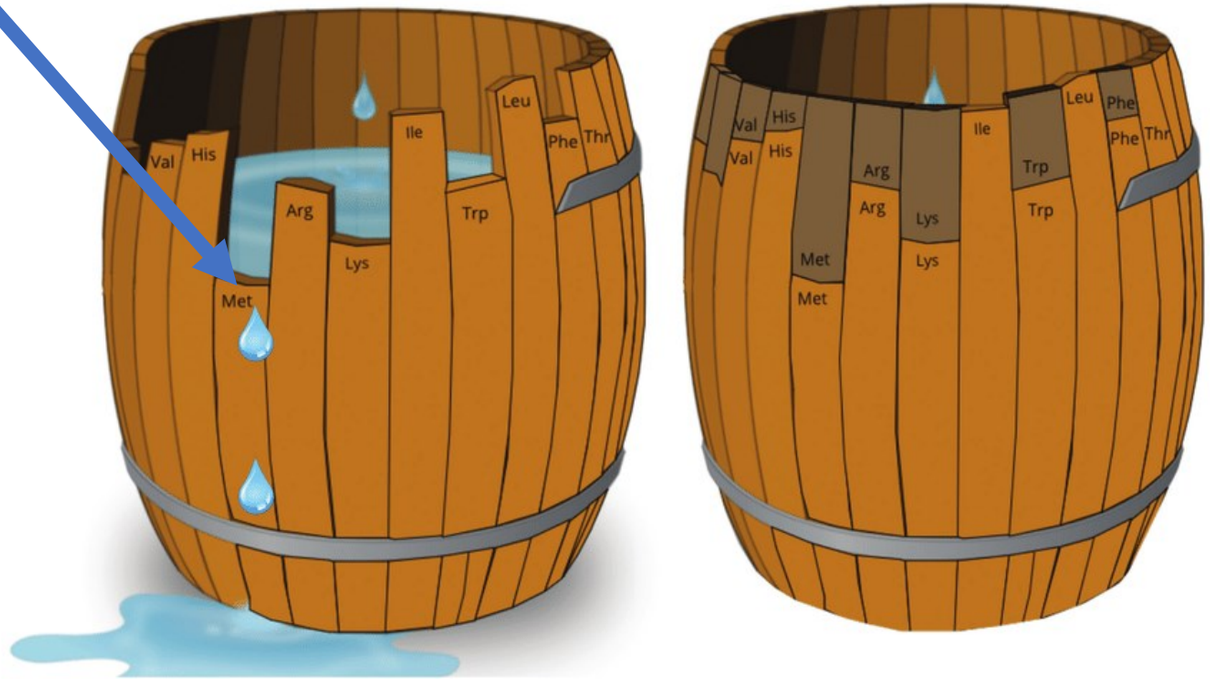
Upcycle low-quality biomass to human food chain



Gluten

Globulin

Legumin



POND

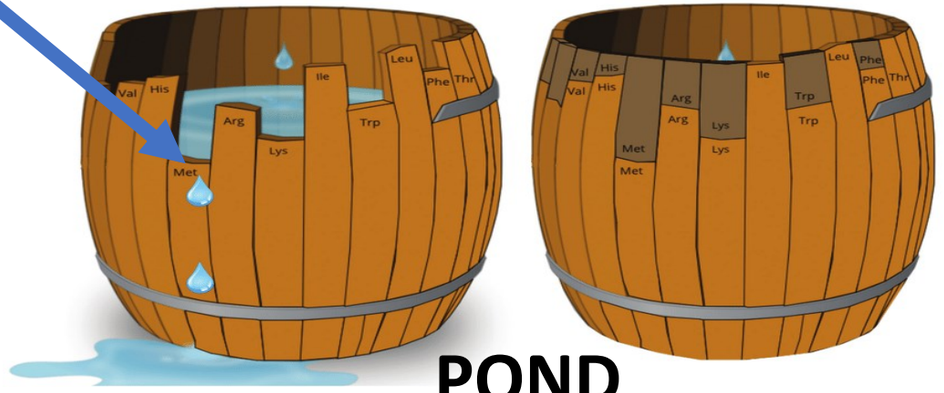
https://doi.org/10.1016/j.aquaculture.2023.739906

LOCAL ENERGY FEEDS

Upcycle low-quality biomass to human food chain

Nutrient bioeconomy

Lowering AA requirement for growth
Food web Protein + PUFA sparing

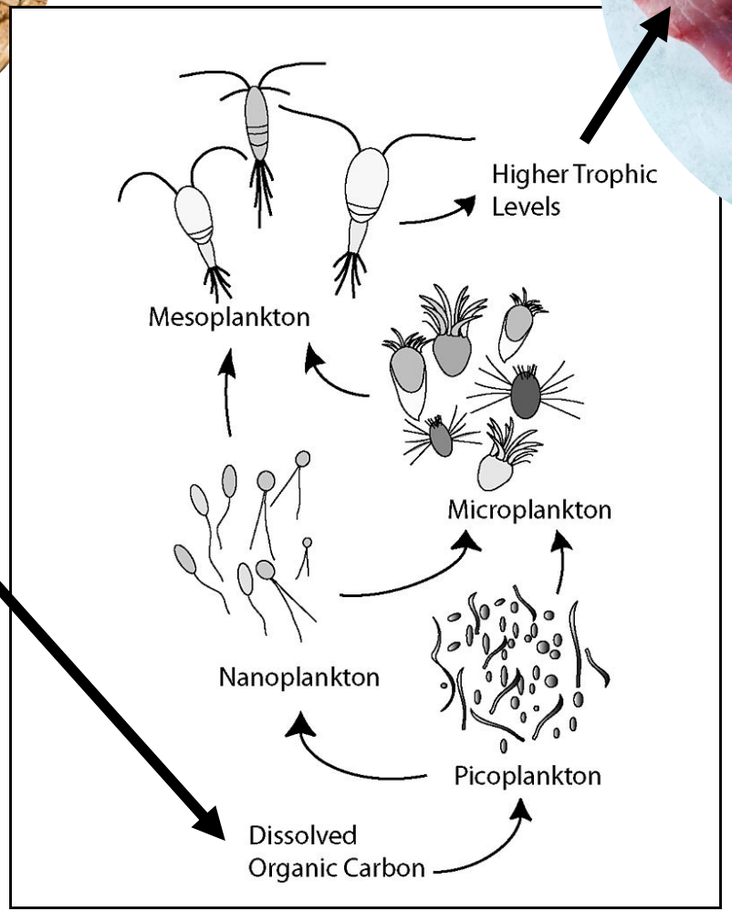


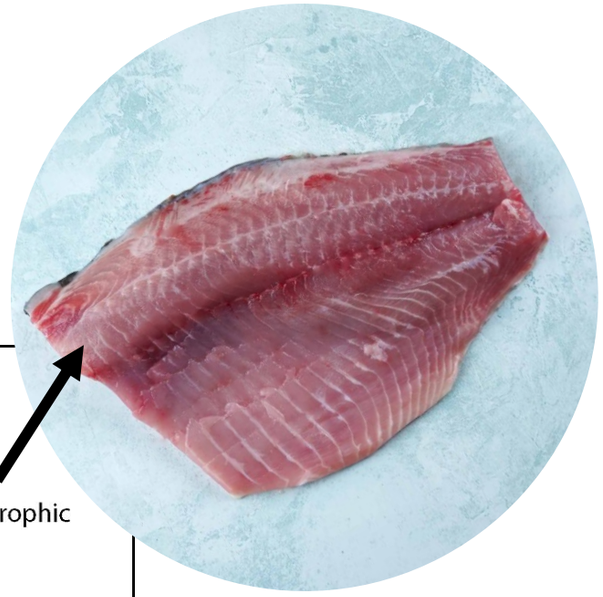
POND

https://doi.org/10.1016/j.aquaculture.2023.739906

LOCAL FIBROUS FEEDS

Upcycle low-quality biomass to human food chain





https://doi.org/10.1016/j.aquaculture.2023.739906











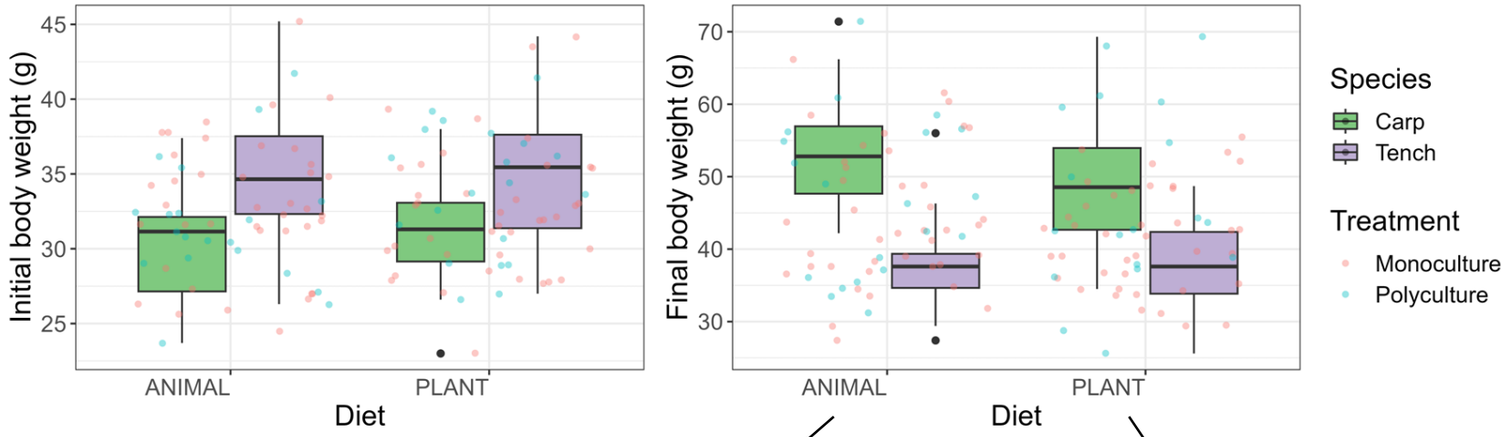
Design of pond feeds

- ❑ Low protein feed <25-28% designed on digestible amino acids basis (DIAAS criteria).
- ❑ Balance lysine and methionine quality to complement zooplankton and zoobenthos lysine-methionine.
- ❑ Add starch and lipid to supply non-protein energy to fish.
- ❑ Add plant fibers to supply carbon (energy) to pond food web.
- ❑ While adding fibers make sure NDF:ADF ratio is >2:1 (carp can ferment those), and Starch content >20-30%
- ❑ Limit P content to <0.9% to respect EU-WFD and stay below zooplankton-zoobenthos P content (1% DM)

https://doi.org/10.1016/j.aquaculture.2023.739906

Kuebutornye, F.K.A., Tellbüscher, A.A., Dvorak, P., Roy, K., Mraz, J. 2024. Valorising local agri-food by-products for circular pond feeds in Central European fishponds: evaluation of protein, fillers, and energy feed resources for ponds. *Animal Feed Science and Technology* (under review).

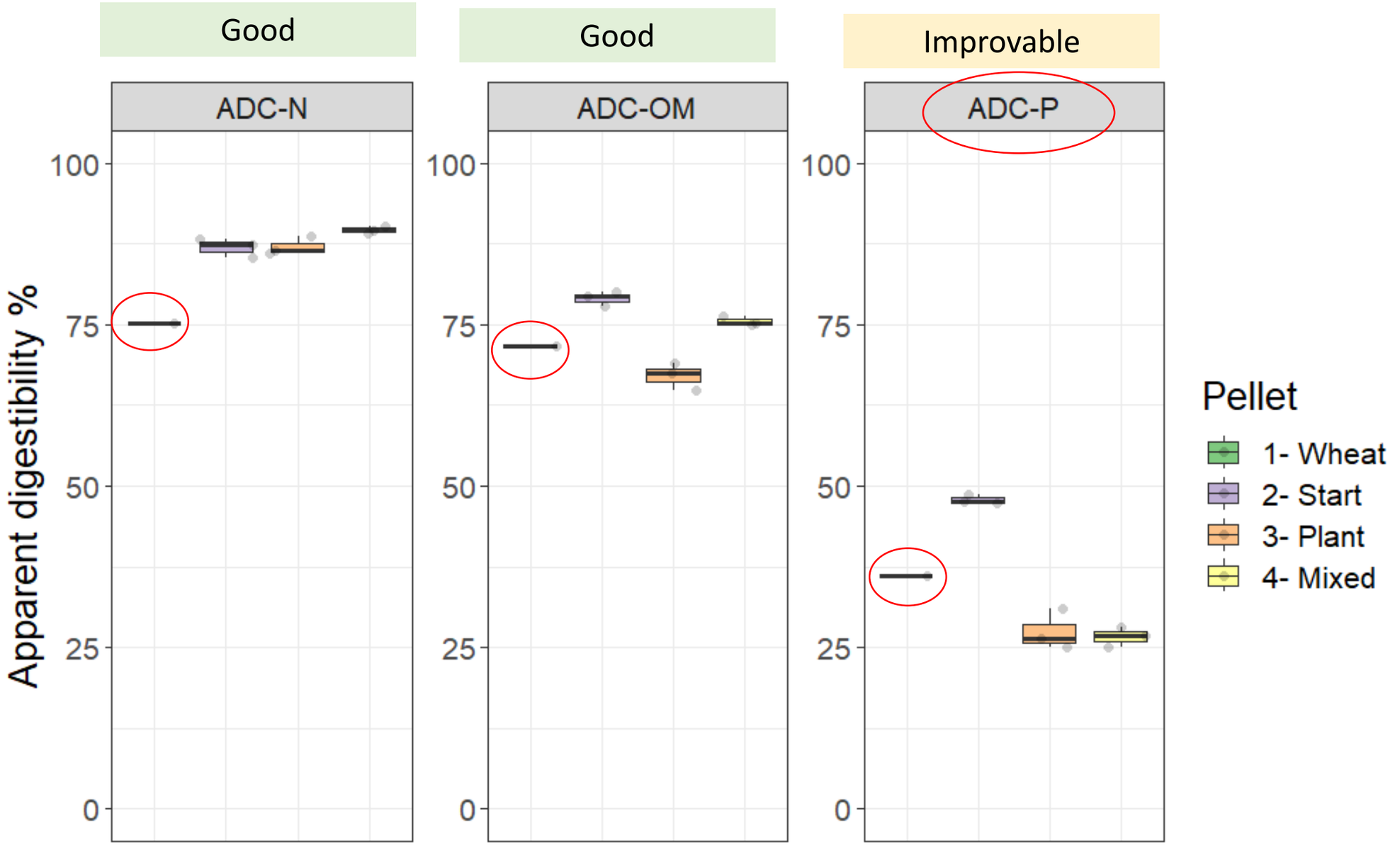
Designed and lab-validated pond feeds



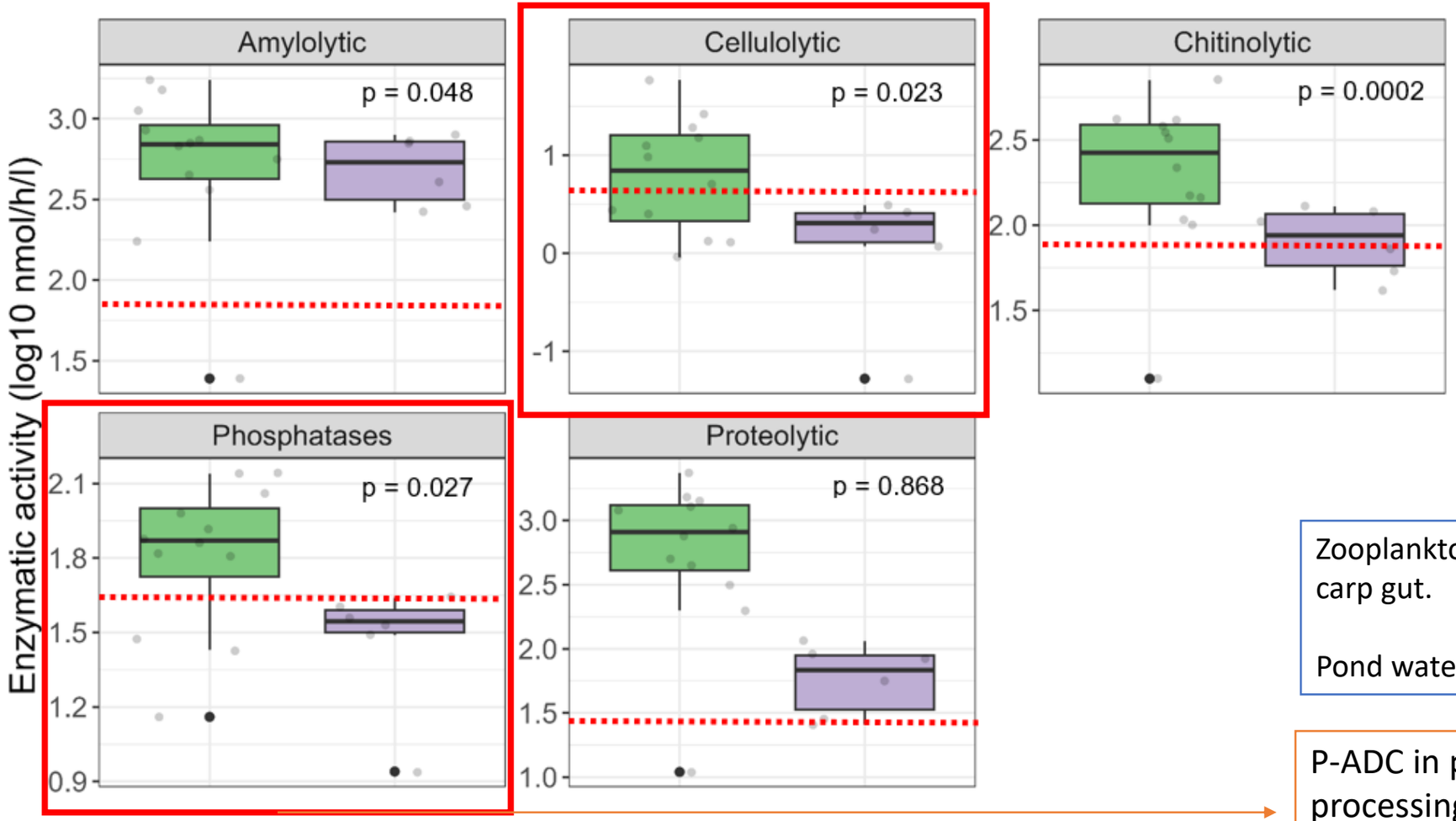
We have developed two iso-protein (28%), iso-energetic (274 kcal/ 100 g), and iso-performing "**Circular pond feeds". Fulfilling carp requirements.**

RECIPE FOR 1000 G/ 1 KG "MIXED" Feed	
INGREDIENTS	**FORMULA (GRAMS)**
Rohlik/ Bread	
Sugar beet/ cukrove repy	
Pea/ Hrasek	
Corn DDGS	
Malt flour (barley DG)	
Fish meal CZ - freshwater	
Total	1000.00

RECIPE FOR 1000 G/ 1 KG "PLANT" Feed	
INGREDIENTS	**FORMULA (GRAMS)**
Rohlik/ Bread	
Corn DDGS	
Rapeseed expeller	
Sunflower expeller	
Rapeseed oil	
Total	1000.00


Good
Good
Improvable
ADC-N
ADC-OM
ADC-P
Apparent digestibility %
100
75
50
25
0
Pellet
1- Wheat
2- Start
3- Plant
4- Mixed

Synergistic digestibility effect in pond carp (Enhanced by pond system)



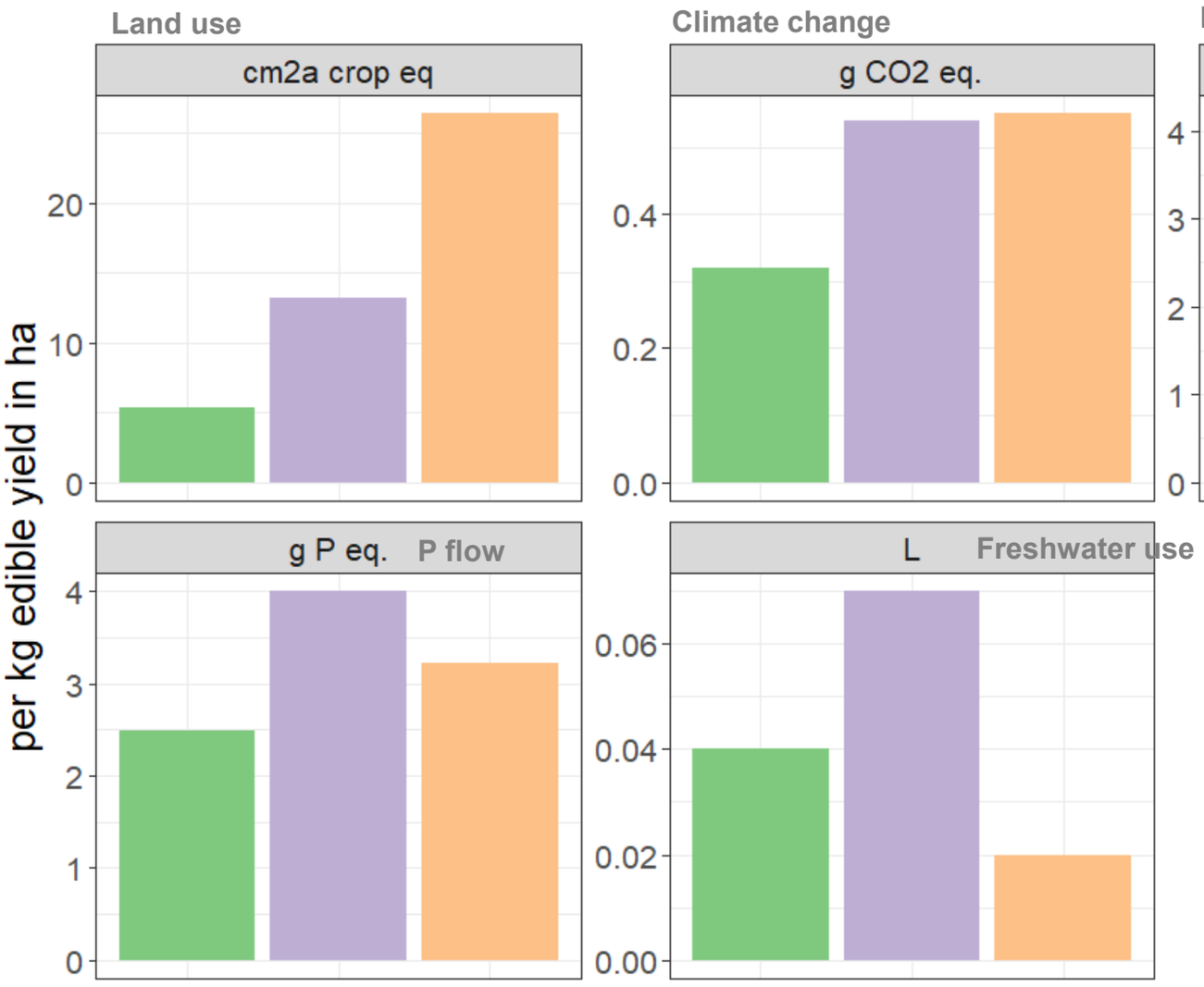
Roy, K., Kajgrova, L., Capkova, L., Zabransky, L., Petraskova, E., Dvorak, P., Nahlik, V., Kuebutornye, F.K.A., Blabolil, P., Blaha, M., Vrba, J., Mraz, J., 2024. Synergistic digestibility effect by planktonic natural food renders high digestion efficiency in aquatic consumers – validation in an agastric pond carp model. Submitted.

Zooplankton-zoobenthos contribute enzyme in pond carp gut.

Pond water and microbiota too.

P-ADC in ponds could be 1.5x higher. With right processing technology we could further optimize it.

Environmental impact of yield from farm to fork



Treatment: Balanced pond feeding with Circular pond feeds

Group

1- WHEAT+PLANT (Balanced 1)

2- START+MIXED (Balanced 2)

3- WHEAT only (Traditional)

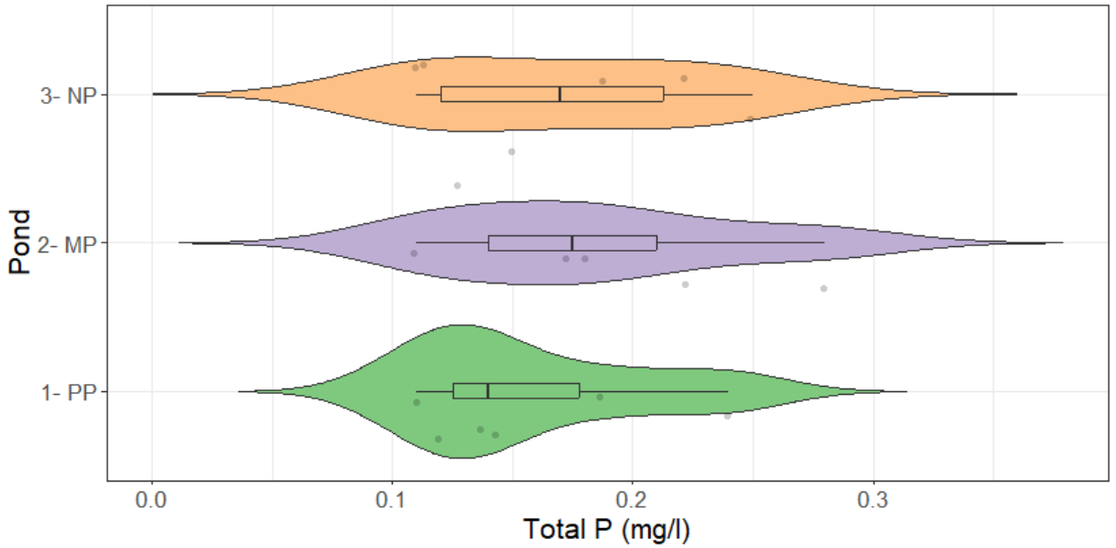
Control: Traditional pond feeding with only wheat

Treatment: 1.5 ton/ ha; FCR 1.8; edible yield 45%

Control: 0.9 ton/ ha; FCR 2.6; edible yield 39%

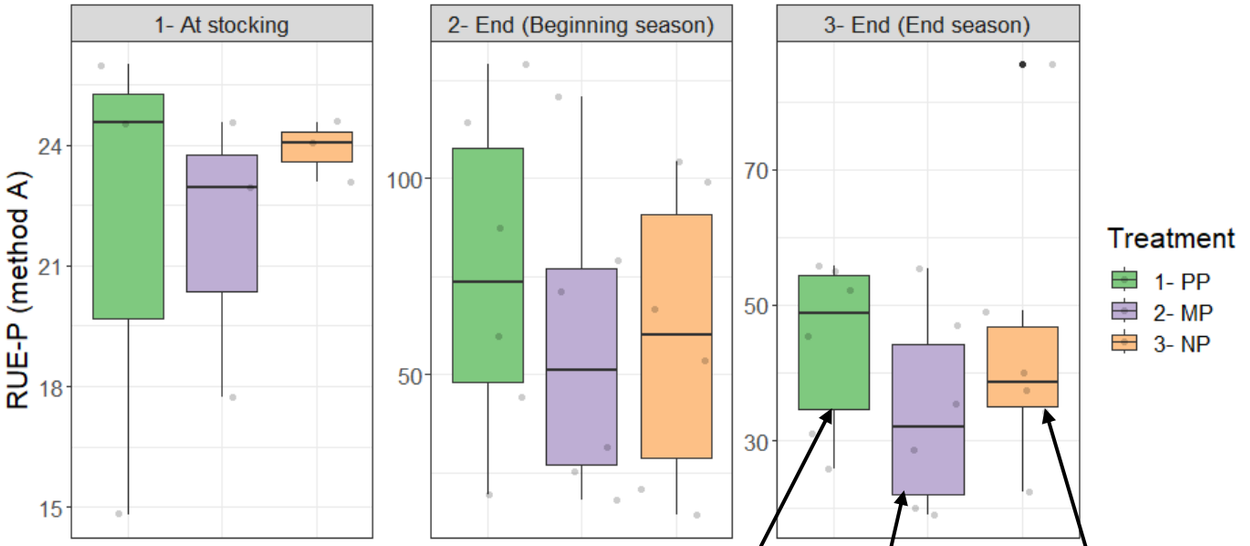
Eco-efficiency (Phosphorus resource use efficiency)

End-of-culture P level in pond water



Same irrespective of feeds

P resource use efficiency in ponds



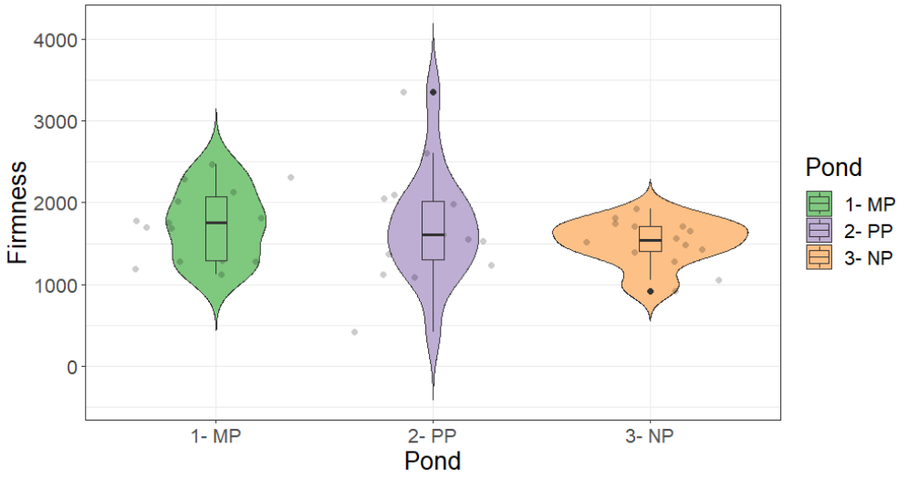
Circular pond feed (mixed plant- and fish-based)

1.5 ton/ ha; FCR 1.8

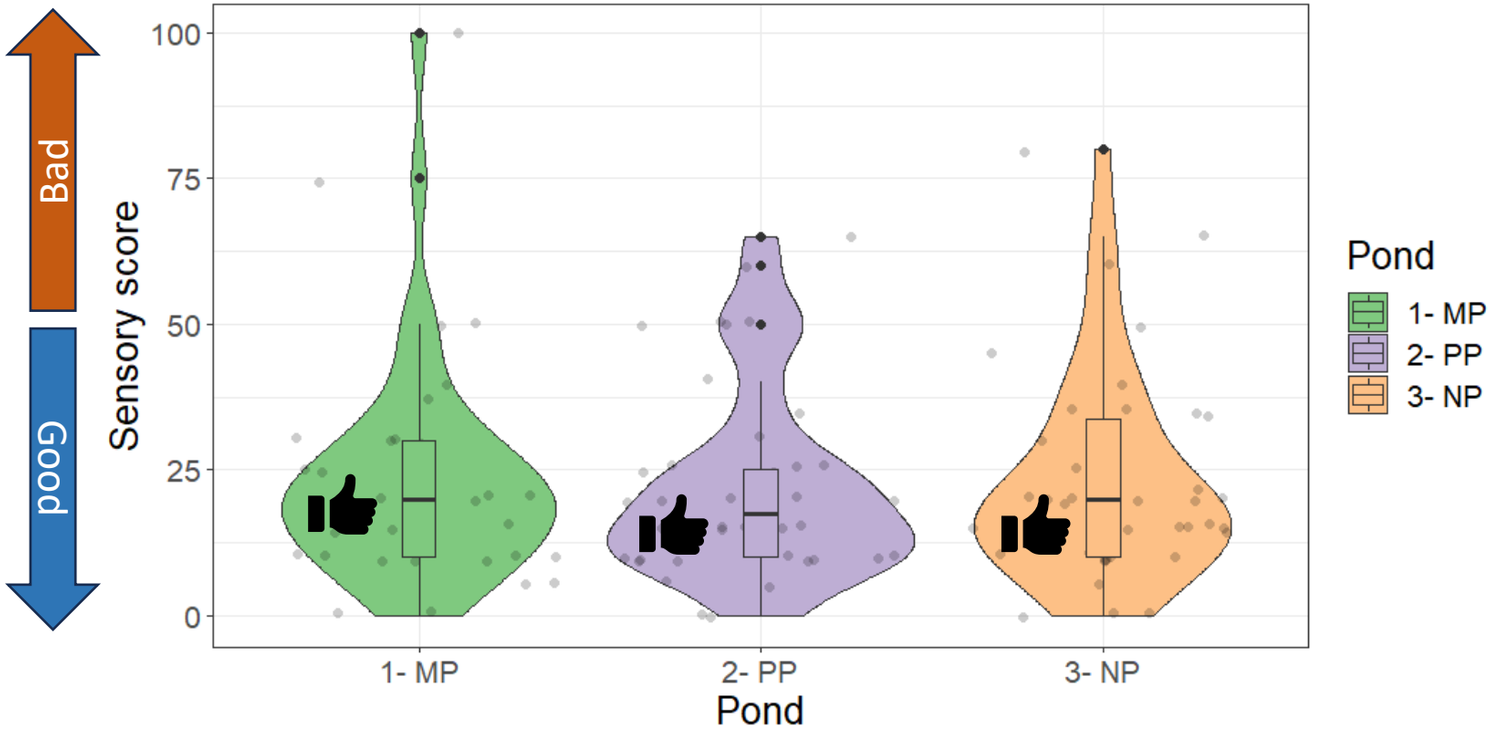
Circular pond feed (plant-based)

Feed only wheat

0.9 ton/ ha; FCR 2.6



Machine measurement



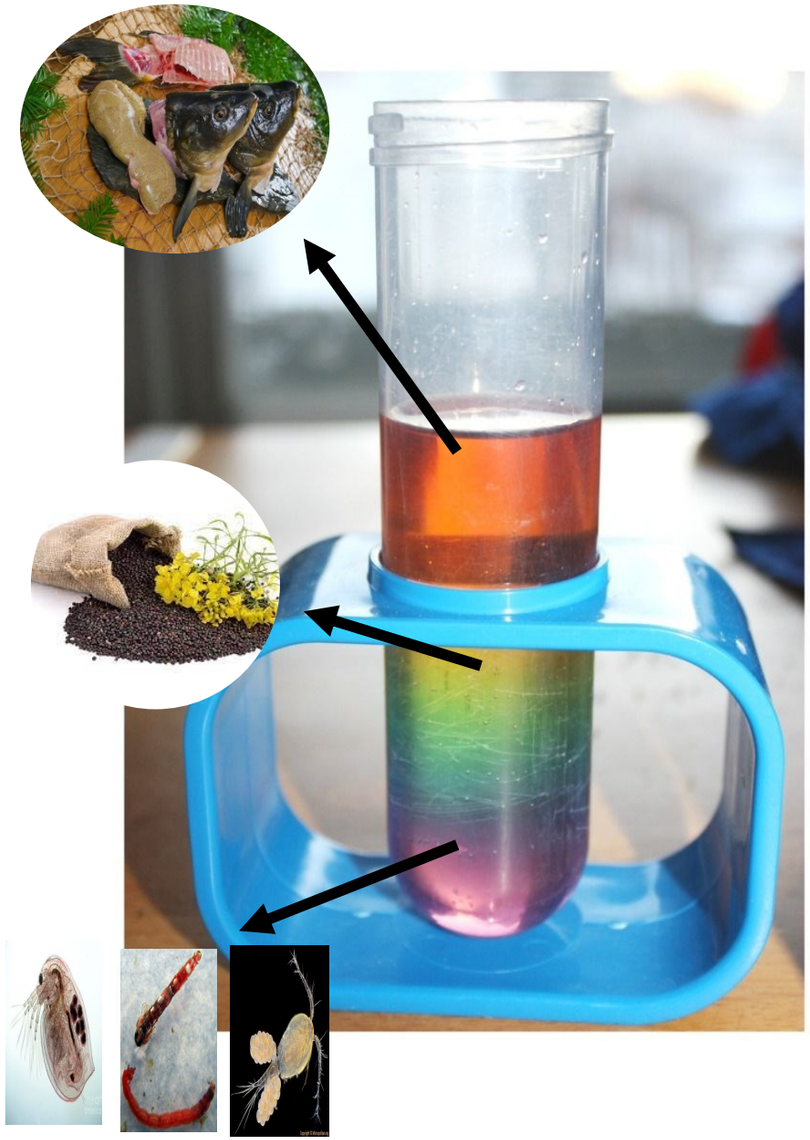
Measured by people

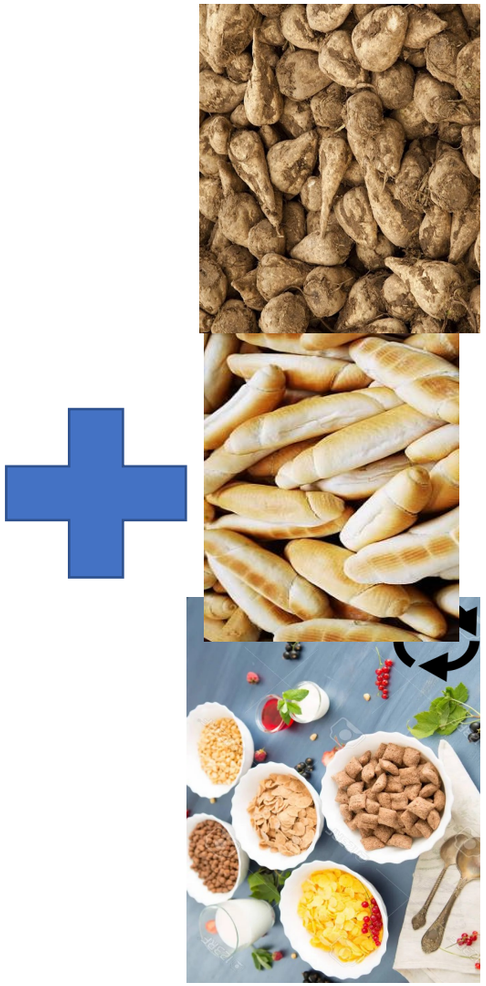
Human RUE (sensory) At Fork

Did not significantly alter the impression of carp fillets at fork (RUE-at-fork), despite CIRCULAR POND FEEDS

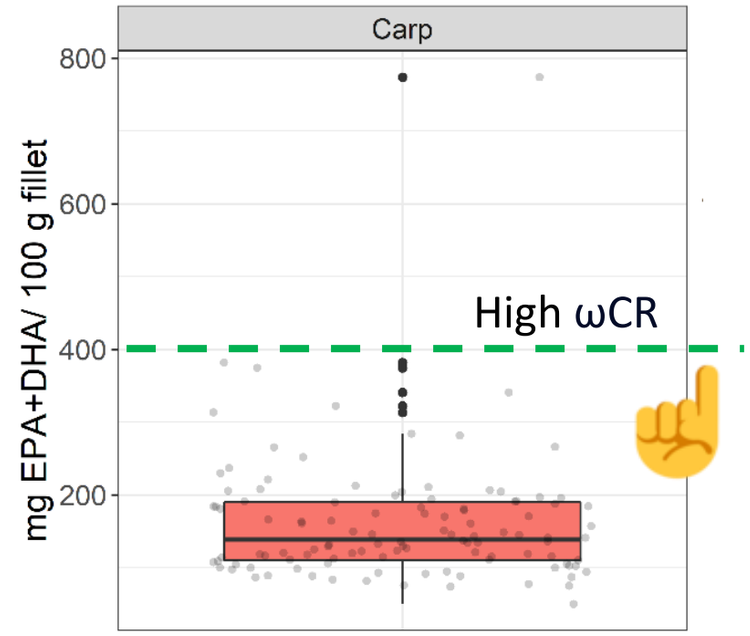
LOCAL LIPIDS FEEDS

Circular finishing feeding strategy in ponds



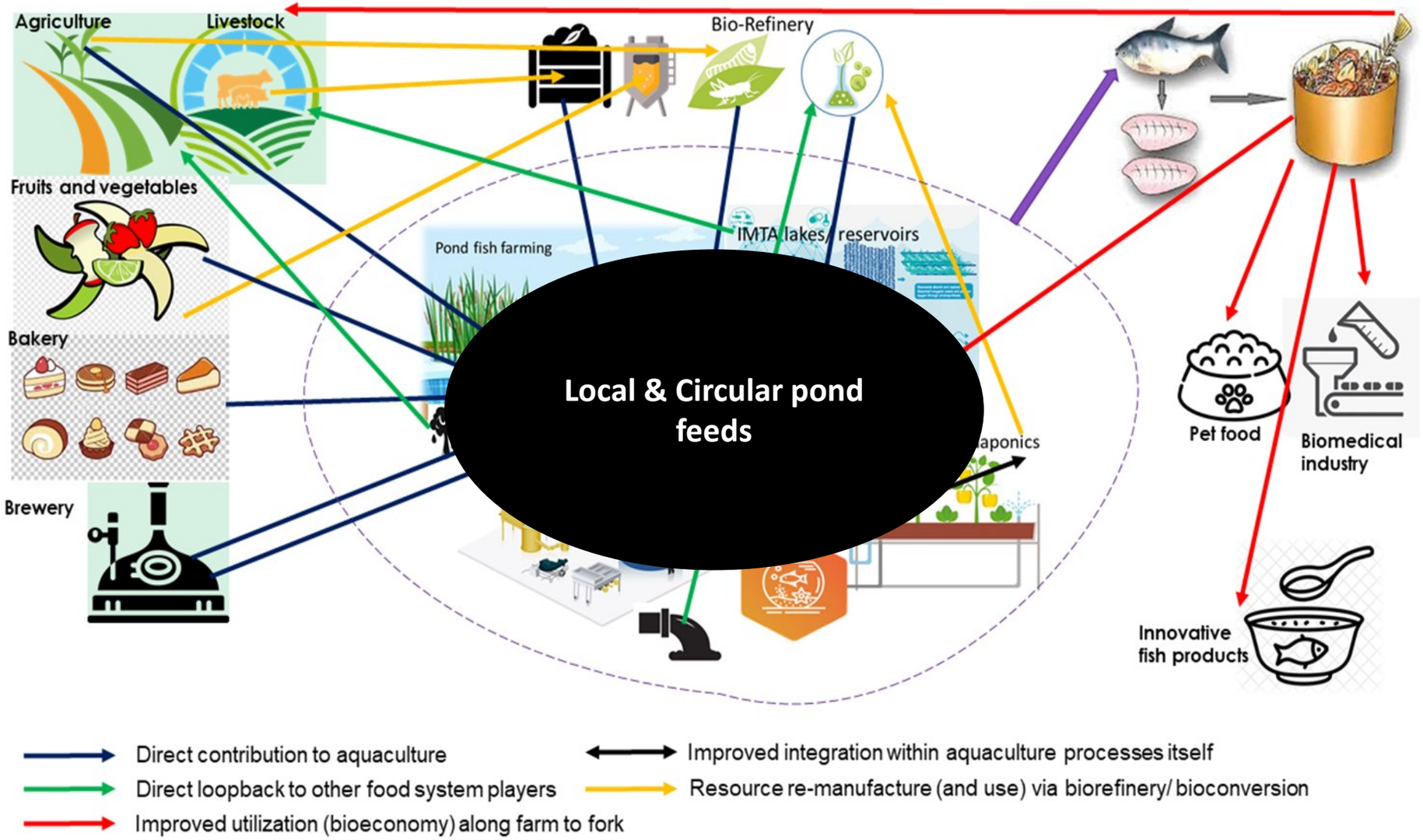


Bioconversion in pond carp



https://doi.org/10.1038/s41538-023-00224-z

BioRural-like initiatives in Czechia



https://theses.cz/id/x5kl9n/Thesis_Roy.pdf

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Faculty of Fisheries and Protection of Waters

Collaborate with us

Projects related to fishponds, multi-trophic systems, environmentally sustainable and circular blue foods/ aquaculture, and fish as food.

- dr. Koushik Roy, Ph.D / kroy@frov.jcu.cz (deputy of lab of nutrition, nutrition working group)
- Assoc. Prof. Jan Mraz, Ph.D. / jmraz@frov.jcu.cz (head of lab of nutrition)
- Laboratory URL: https://www.researchgate.net/lab/FROV-Laboratory-of-Nutrition-Jan-Mraz