Effect of feeding *Candida utilis* yeast on intestinal development and health in post-weaning piglets

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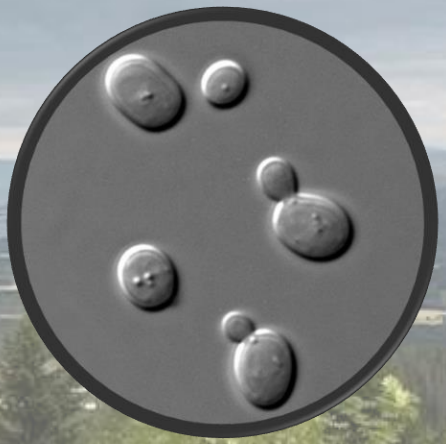
Need for novel protein sources

2050, ~9 billion people

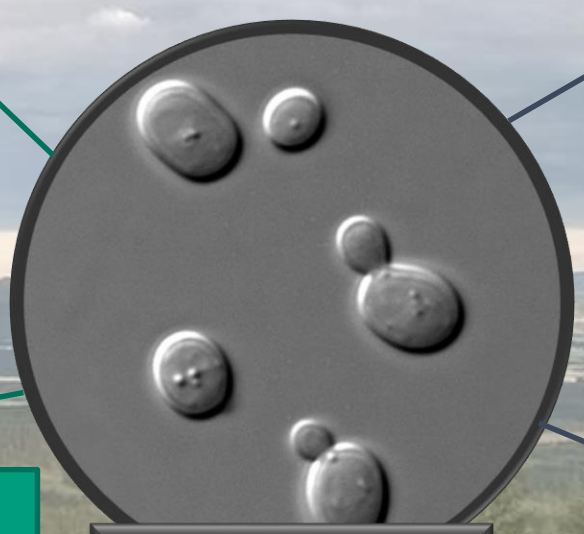
Competition for protein sources



Microbes –
A promising new source

Sustainable production

- Utilize non-food biomasses
  - Lignocellulosic biomass (Øverland & Skrede 2017)
  - Seaweed (Sharma et al. 2018)
- Production independent of climatic conditions and cultivated area



YEAST

Protein source

- 50-60 % crude protein

- Improve intestinal health
  - Stimulate immune system (Vetvicka & Oliveira 2014)
  - Improved villus height & crypt depth (Bontempo et al. 2006)
  - Improved digestibility of protein and increased fecal DM (Cruz et al. 2019)

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Candida utilis yeast as a protein source for weaned piglets: Effects on growth performance and digestive function

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Highlights

- Up to 40% of the crude protein in traditional piglet diets was replaced by yeast.
- The yeast *Candida utilis* was grown on local lignocellulosic biomass.
- Digestive function improved and growth performance was maintained.
- The digestibility of crude protein and minerals improved.
- Intestinal villi-height and fecal dry matter increased.

Hypothesis:

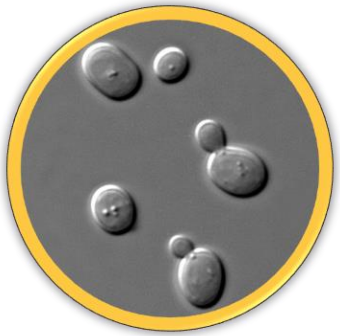
Yeast will improve early post-weaning gastrointestinal function and health

Dietary treatments

Ingredient, g/kg as fed	Control	Yeast
Wheat	628.8	594.6
Barley	100.0	100.0
Oats	50.0	50.0
Soybean meal	80.0	19.2
Potato protein conc.	33.8	9.1
Fish meal	20.0	4.8
Rapeseed meal	20.0	4.9
Yeast - *Candida Utilis*	-	146.0
Rapeseed oil	19.7	23.4
Vitamins, minerals and amino acids	48.6	49.0
Yttrium(III)oxide	0.1	0.1

Nutrients, g/kg of DM	Control	Yeast
Crude protein	202.0	193.9
NDF	110.0	102.4
Starch	508.0	494.3
Crude fat	45.3	46.2

40 % of crude protein from yeast



Experimental Design

72 weanling piglets

27.4 ± 1.2 days old
10.2 ± 1.6 kg

Day
0 2 4 7 14

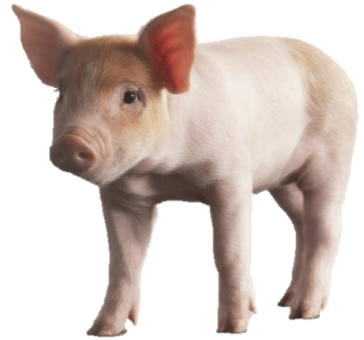
8 littermates

8 control & 8 yeast

8 control & 8 yeast

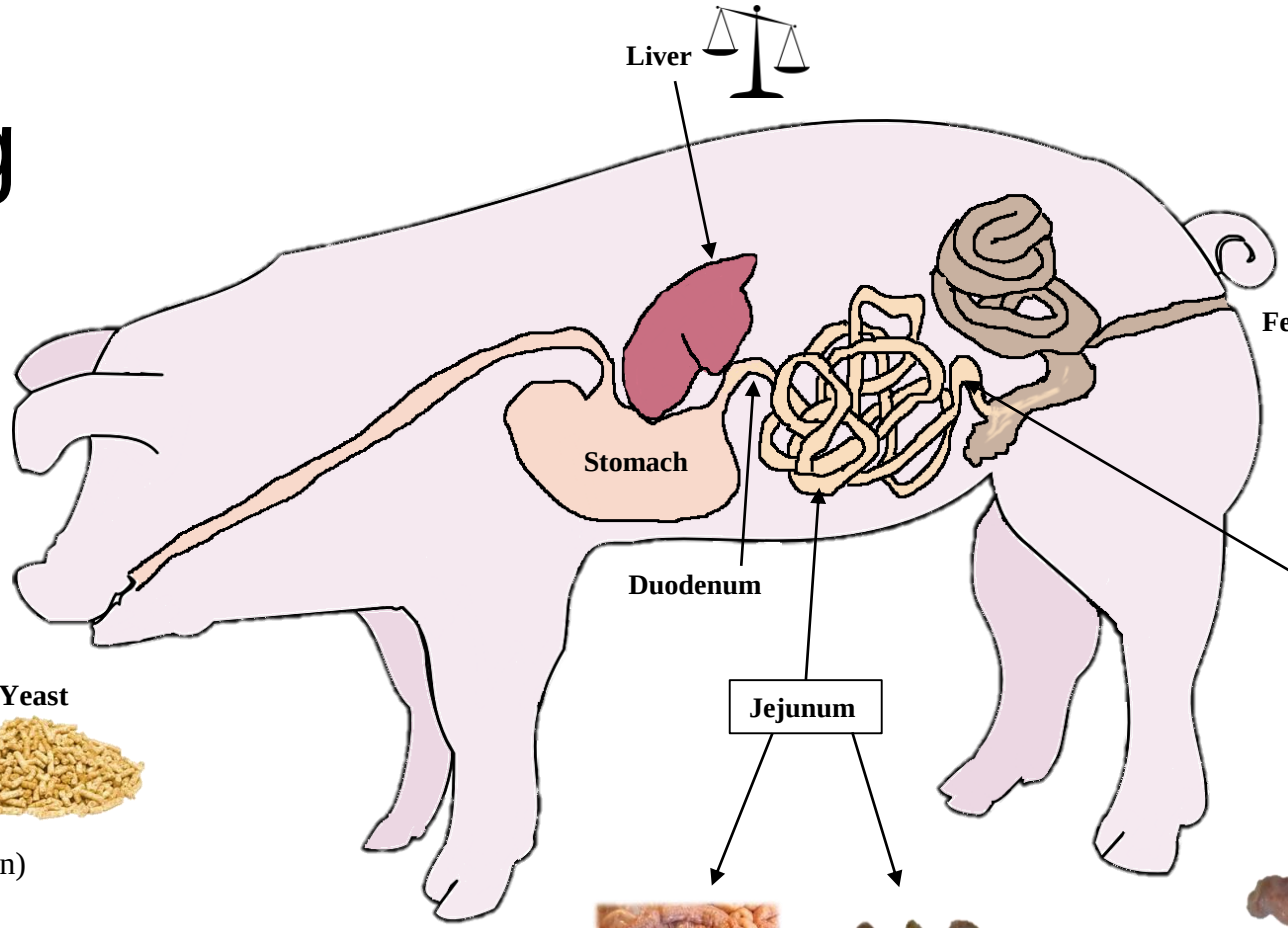
8 control & 8 yeast

8 control & 8 yeast



Sampling of 8 piglets from each treatment on day 0, 2, 4, 7 and 14 post-weaning.

Sampling



Fecal score (pen)

Score	1 Firm and shaped	2 Soft and shaped	3 Loose	4 Watery
Picture				
Texture	Firm. Varies in hardness.	Varies in softness. Like peanut butter	Mush. Often shining surface	Varies form gruel to water.
Shape	Sausage	Varies form sausage shape to small piles	Tends to level with surface. Does not flow through or flows slowly through slatted floors.	Levels with surface. Flows through slatted floors.
In container	Preserves original shape.	Does not flow when container is rotated. Preserves original shape.	Inert when container is rotated. Merges and covers bottom of container in most cases.	Flows easy when container is rotated. Merges and covers bottom of container.

Pedersen and Toft (2011)

Control **Yeast**

Feed intake (pen)
Weight gain

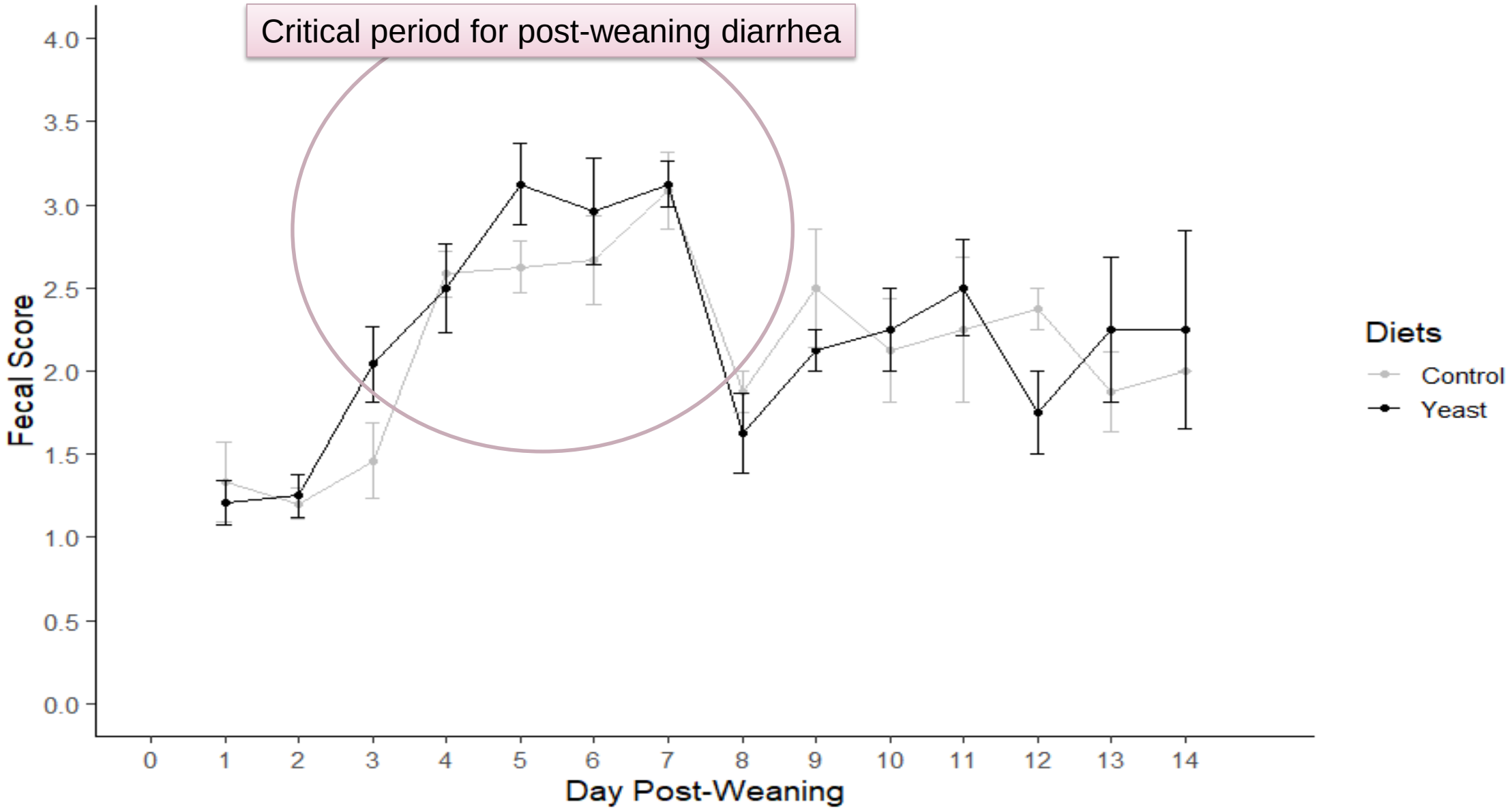
<u>Tissue/mucosa</u>
- Brush border enzymes
- RNA seq
- (VH/CD)

<u>Digesta</u>
- Enzymes
- pH

<u>Tissue</u>
- RNA seq
- (VH/CD)

<u>Digesta</u>
- Digestibility

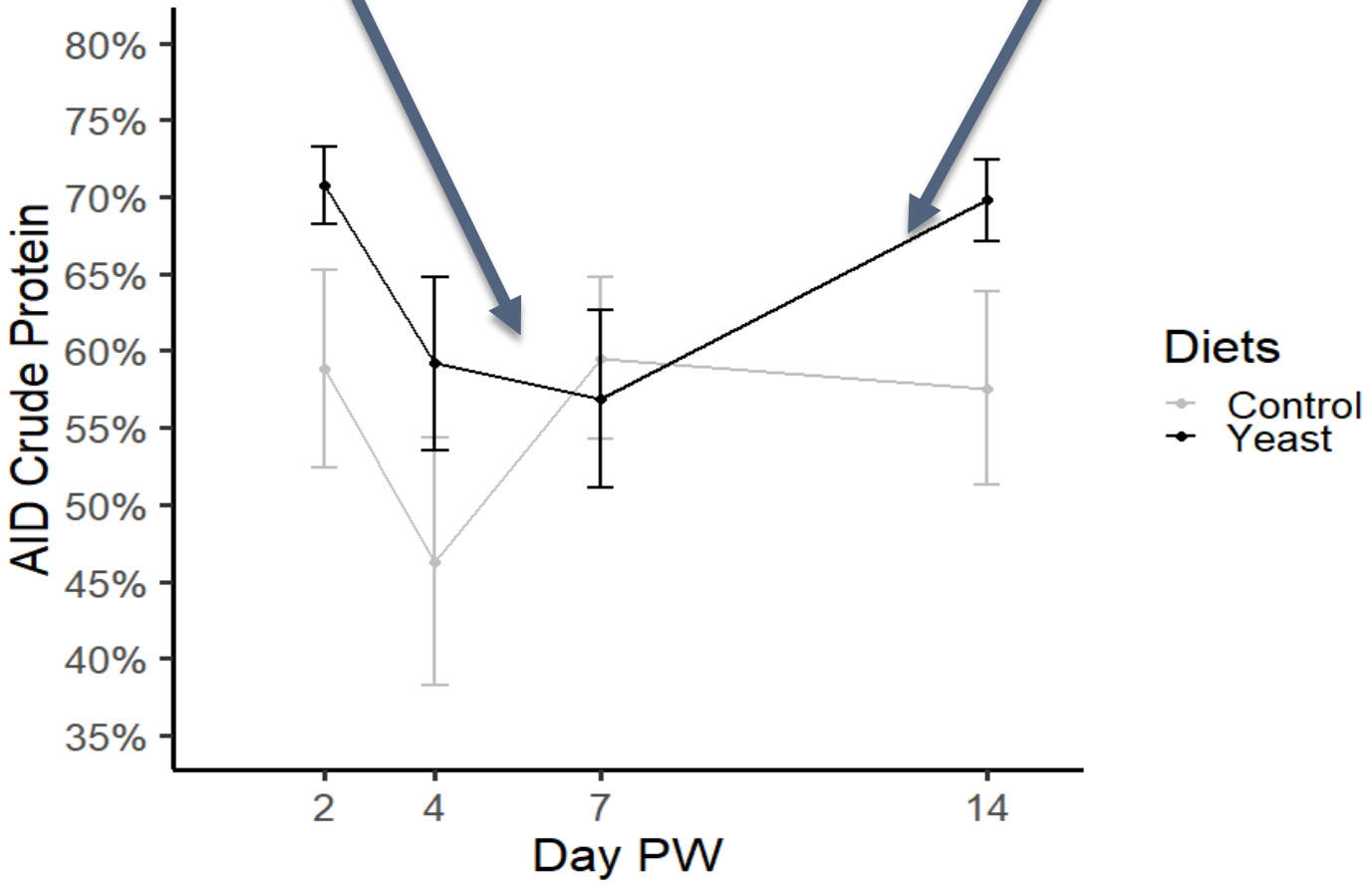
Fecal score


Critical period for post-weaning diarrhea
Fecal Score
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Day Post-Weaning
Diets
Control
Yeast

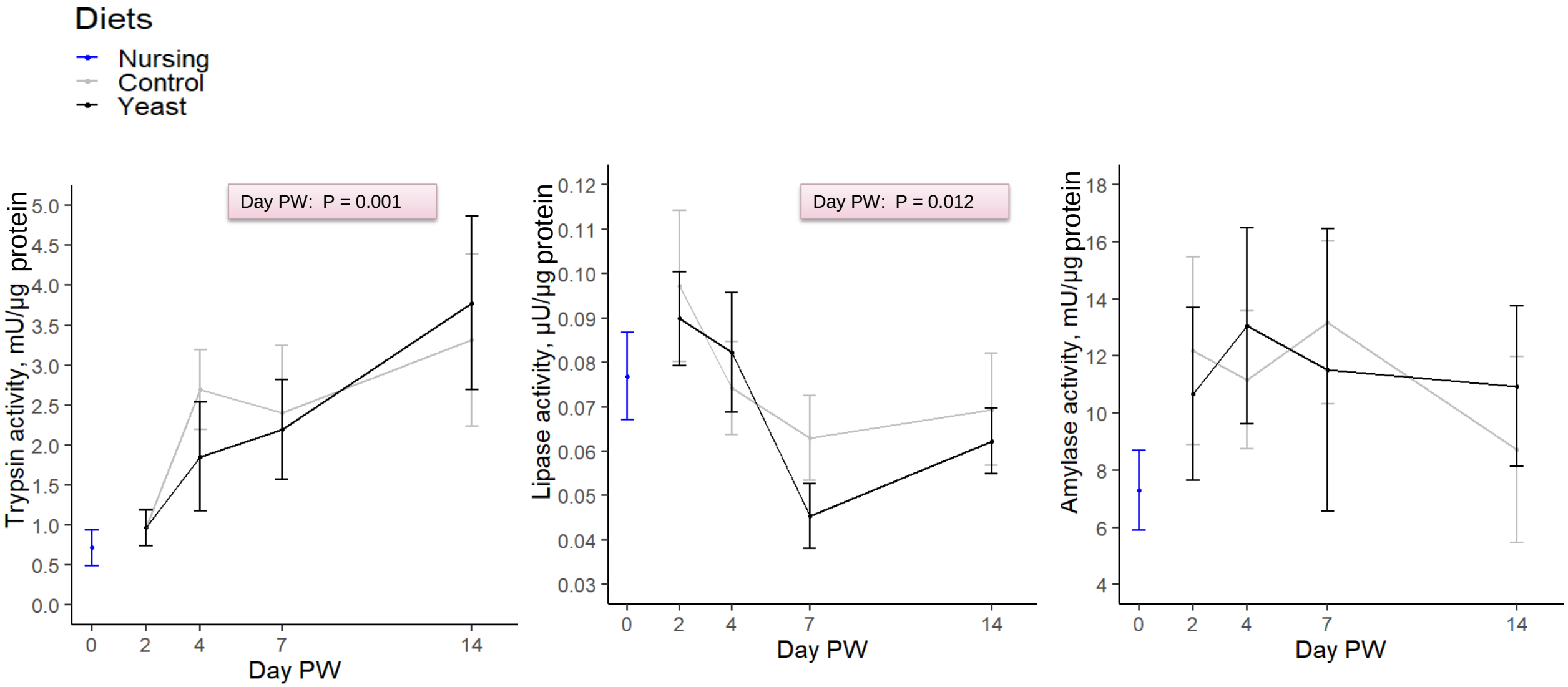
Crude protein digestibility

Drop in digestibility in the diarrhea period around day 4 to 7

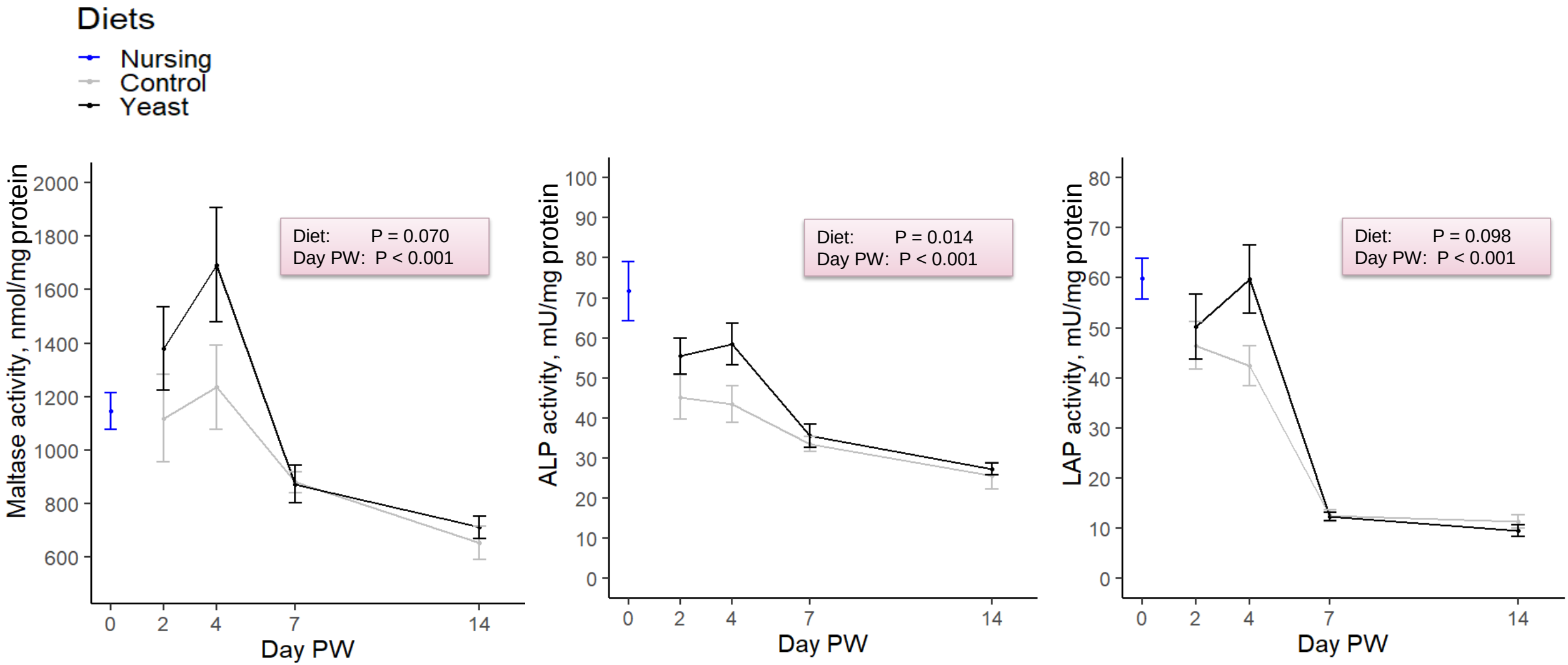
Higher protein digestibility for piglets fed yeast (P = 0.033)



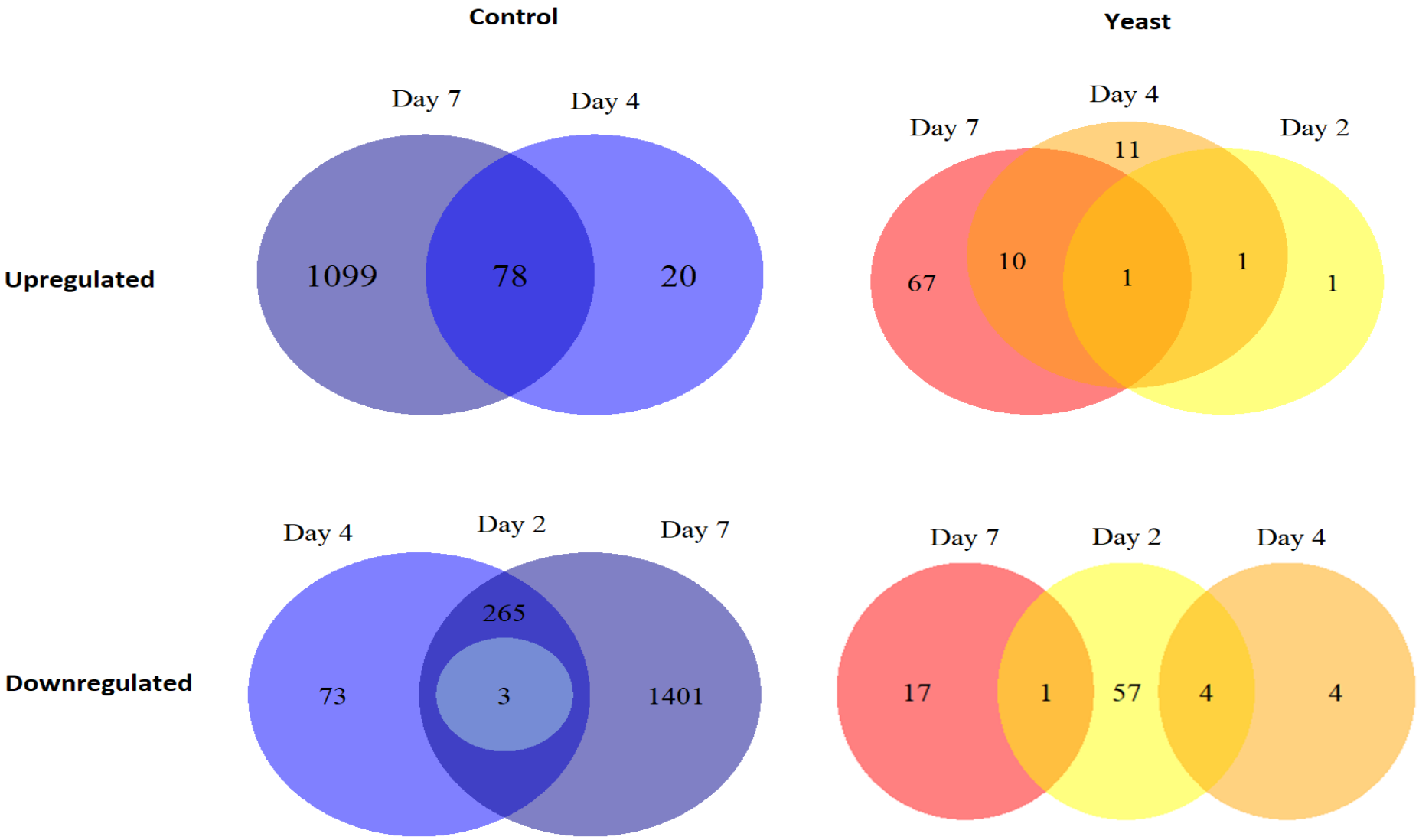
Enzyme activity



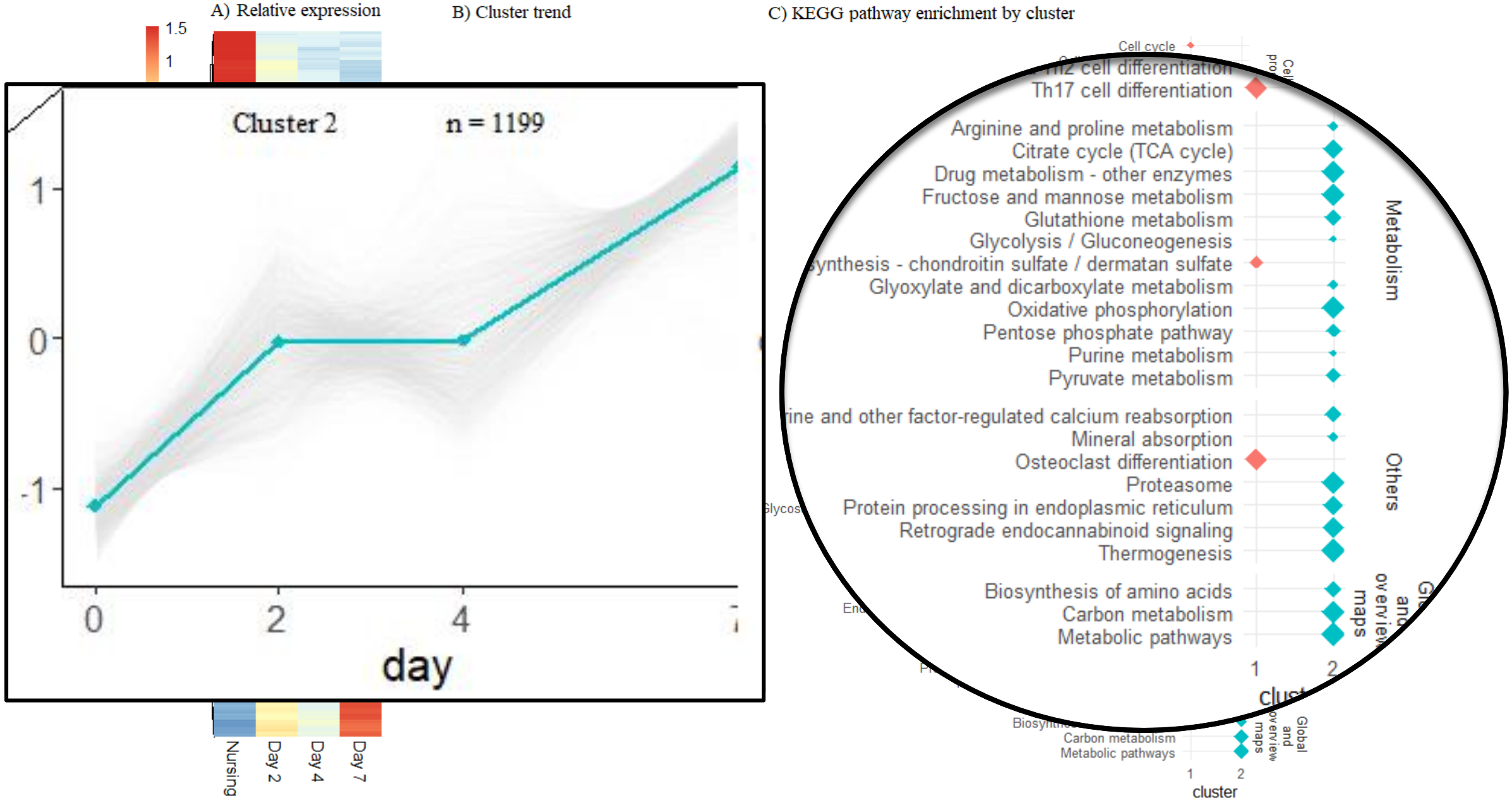
Brush border enzyme activity



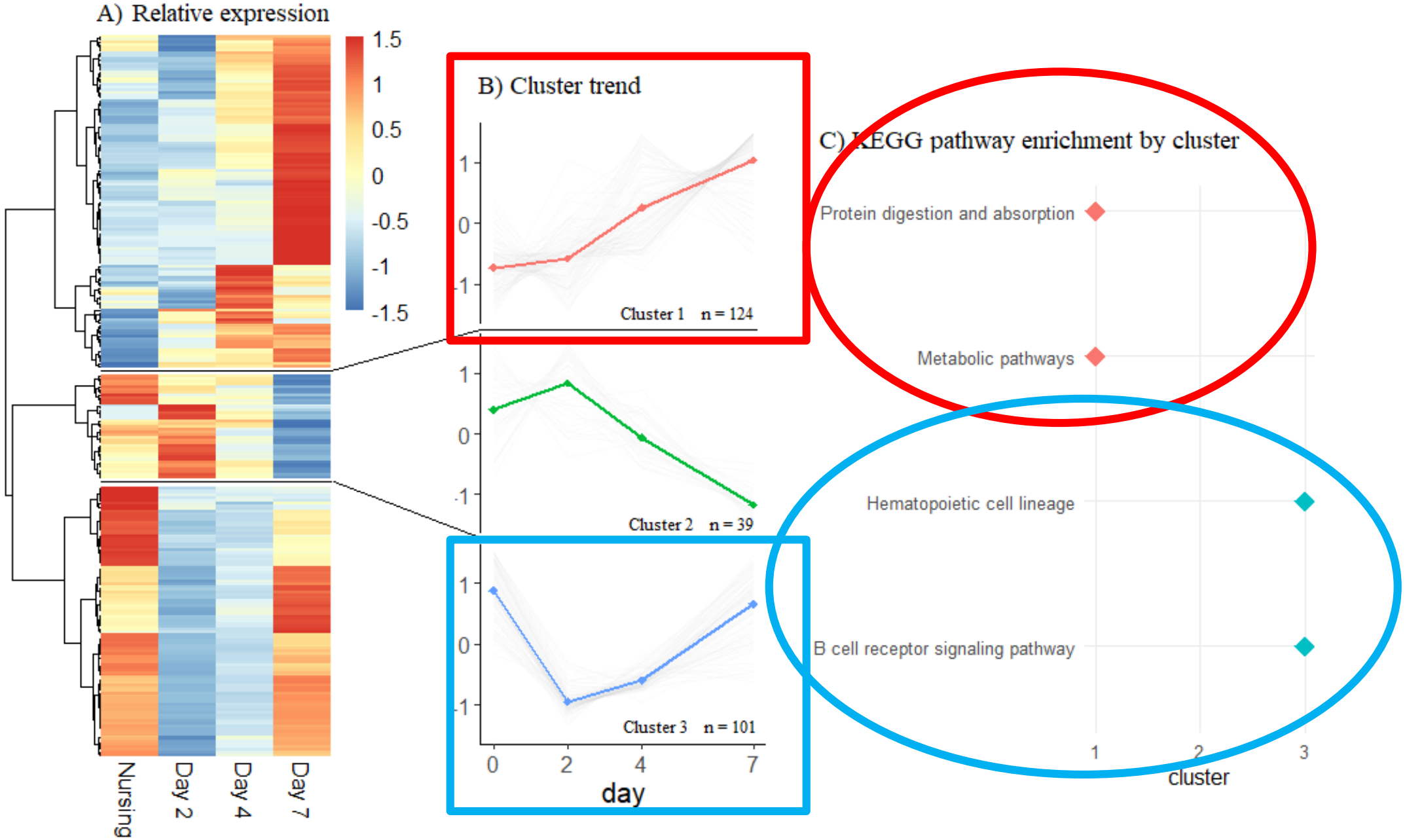
Differentially expressed genes in jejujum compared to day 0



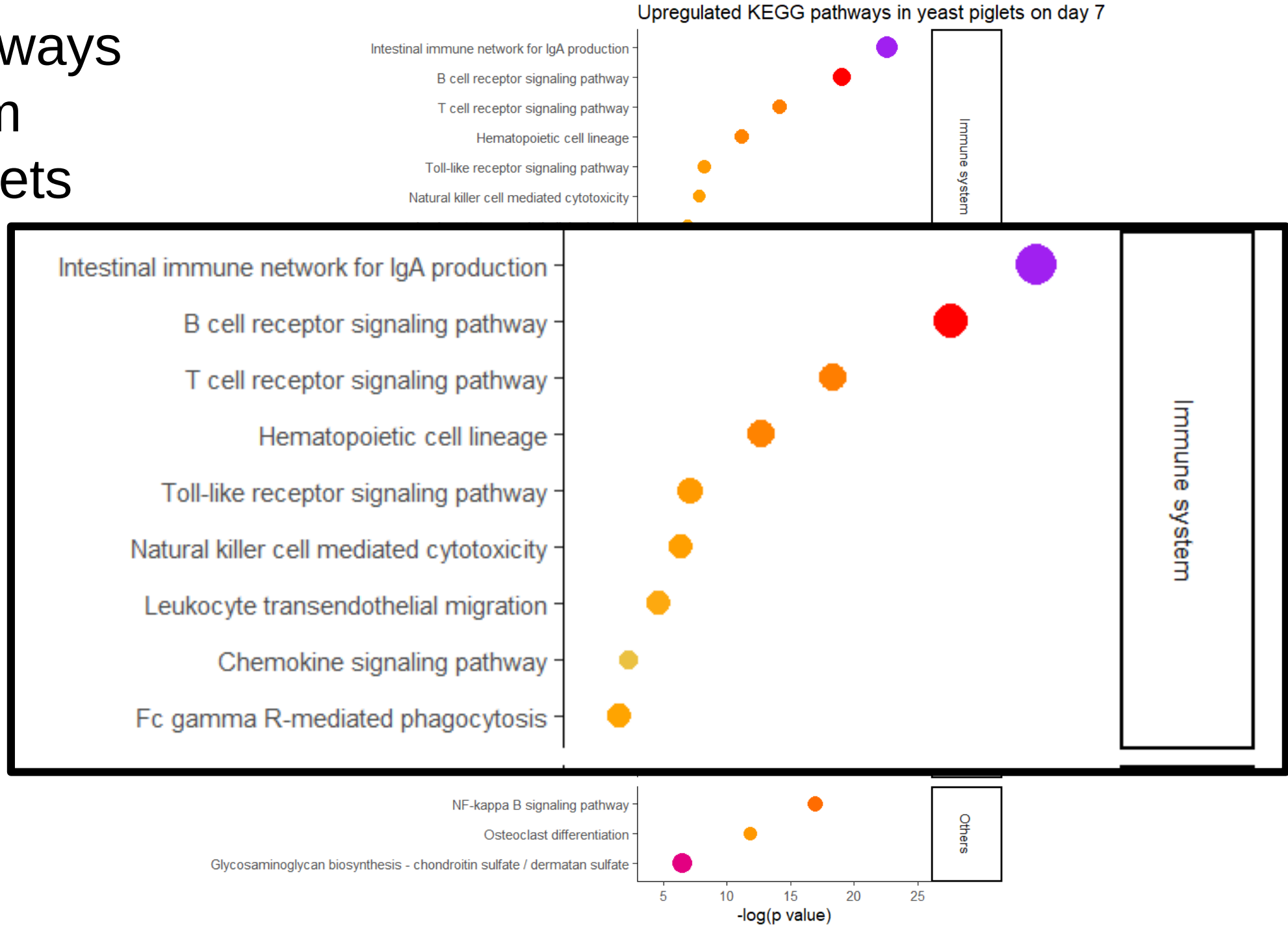
Jejunal gene expression patterns over time for control group



Jejunal gene expression patterns over time for yeast group



Enriched pathways in jejunum of yeast piglets on day 7



Summary

Replacing 40% of protein in the diet with yeast:

Improved post-weaning development of protein digestibility ↑

Improved brush border enzyme activity early post-weaning ↑

Less differences in gene expression compared to day 0
– more homogenous to pre-weaning levels?

↑ Upregulation of immune system pathways ↑


Thank you for your attention!
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