



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



Effect of authorized level of Zn supplied in three different forms on the physiology and performance of piglets weaned at different age

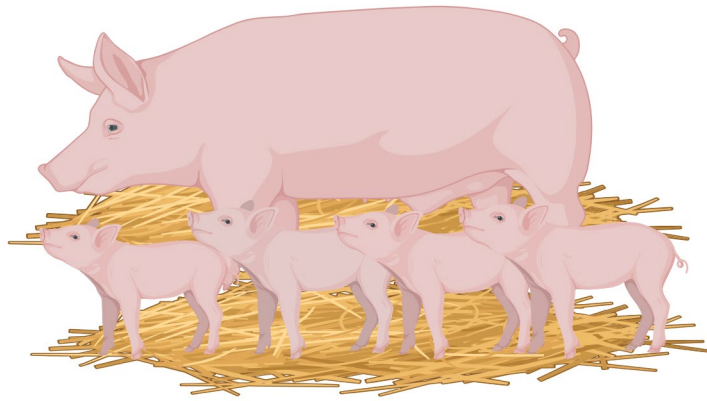
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¹Department of Agro-Food Sciences and Technologies, University of Bologna, 40127 Bologna, Italy;

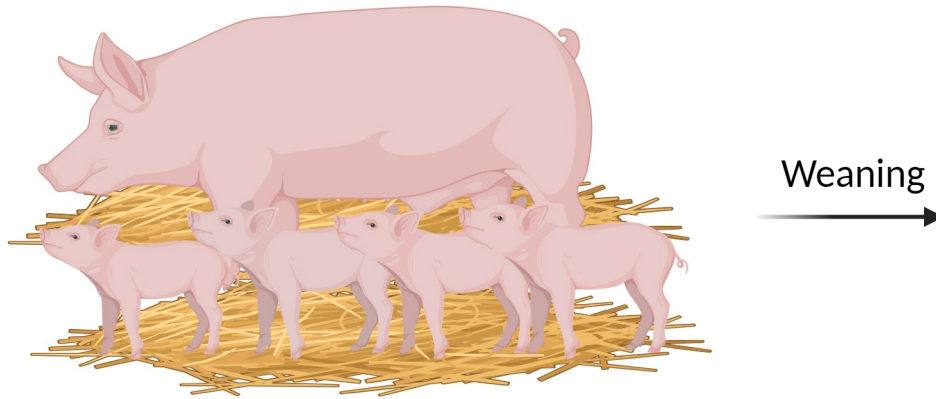
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Weaning ages

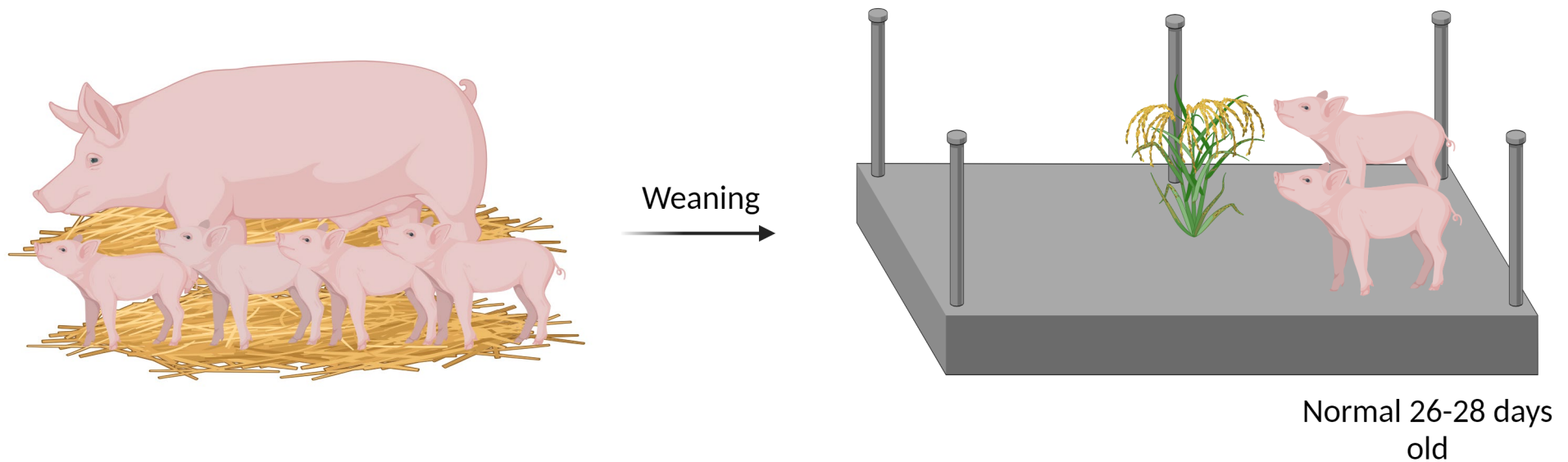


Weaning ages



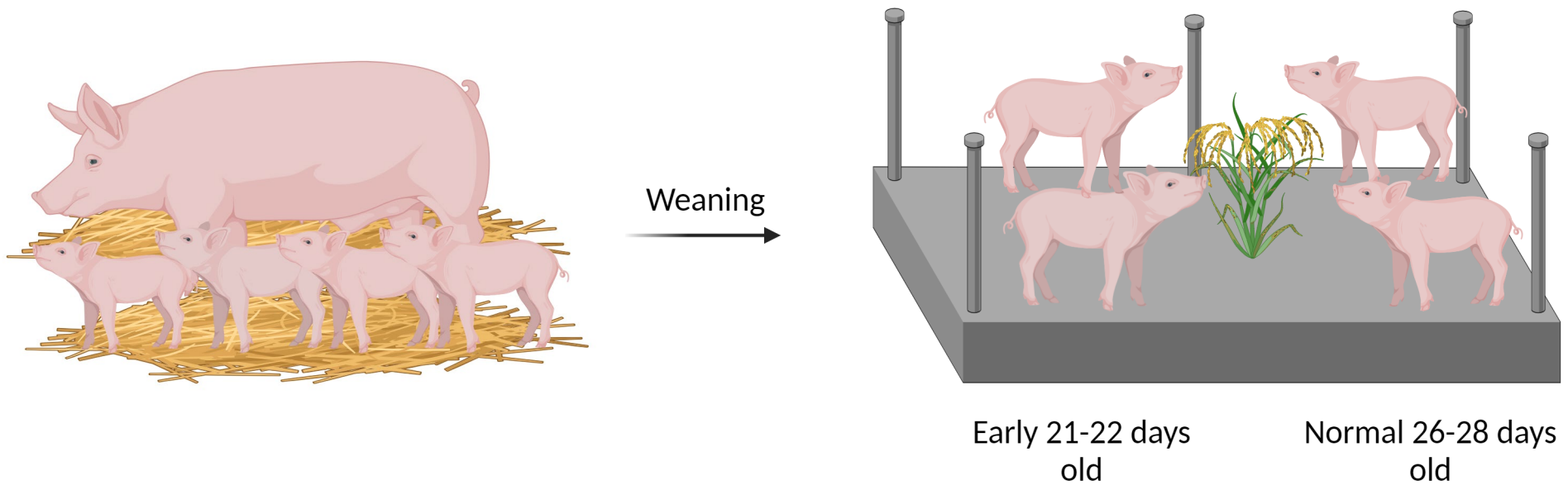
Weaning stress produced by changes in diet, social interactions, and the environment will have a significant detrimental influence on the growth, health, and development of piglets if they are weaned too early (Leliveld et al., 2013)

Weaning ages



As a result, weaning age may have a deleterious impact on nursery pigs' food consumption and mucosal intestinal barrier homeostasis (Moesser et al., 2017)

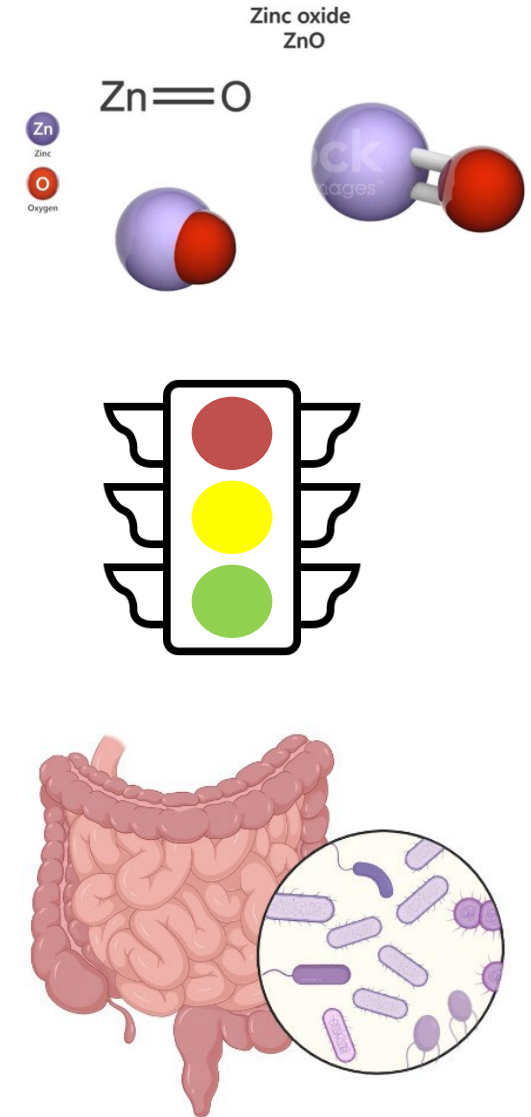
Weaning ages



Early → Problems with development and gut health (Smith et al., 2010)

Background

- 🐷 Pharmacological concentrations of zinc oxide (ZnO) improve growth performance and reduce the incidence of diarrhoea in piglets (Sun et al., 2019);
- 🐷 However, there is a strong correlation between the supranutritional use of ZnO in pig diets and accumulation of Zn in the environment (Burrough et al., 2019);
- 🐷 ZnO could favour the selection of multi-resistant bacteria strains of *Escherichia coli* (Oropeza-Moe et al., 2017);
- 🐷 Due to environmental concerns, in EU, since June 2022, the limit of Zn in the complete feed is 150 mg/kg of feed (EMA, 2017);



Trial hypothesis

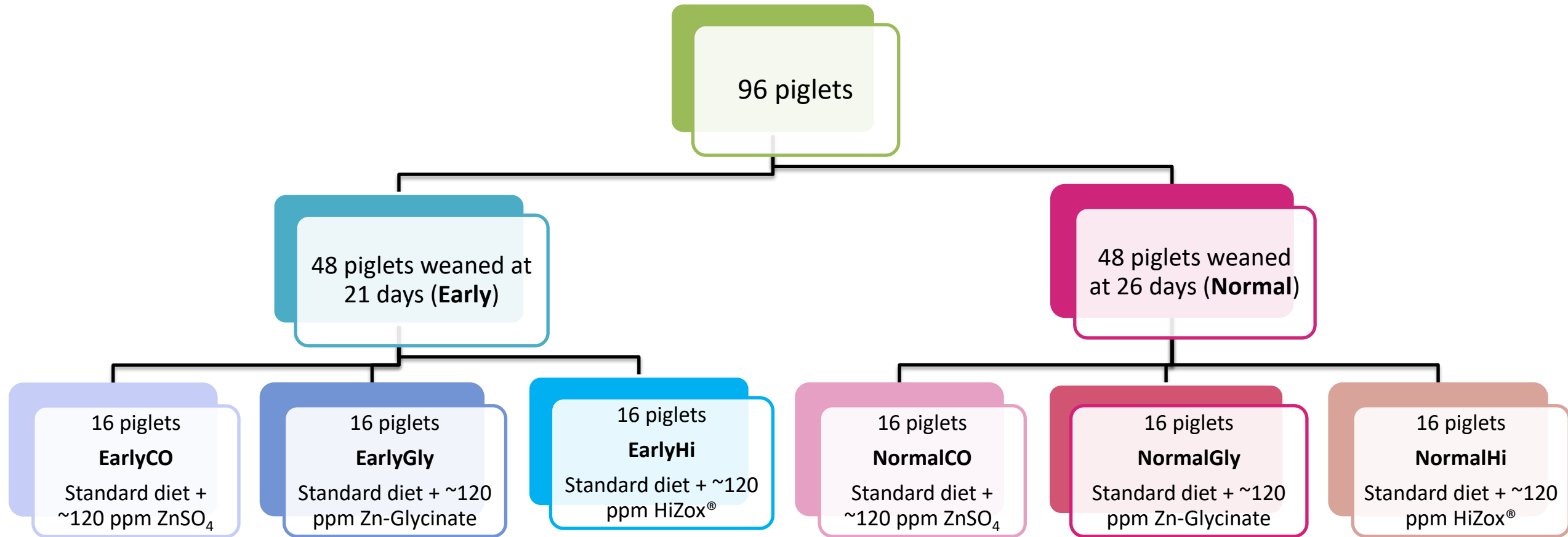
- 🐷 The most used source of Zn in pig production is zinc sulphate (Bonetti et al., 2021);
- 🐷 However, due to the higher bioavailability of Zn as ZnSO_4 , this form of Zn does not show specific effect on gut health;
- 🐷 Several studies reported promising results in the usage of a high porous surface form of ZnO (HiZox®) in alleviating post-weaning gut related issues (Long et al., 2017);
- 🐷 We hypothesised that HiZox®, characterised by a higher surface area and bigger aggregates, alongside with zinc glycine (Zn-Gly), with higher digestibility and availability for metabolic and immune processes of piglets, at nutritional doses could benefit on Early weaned piglets' intestinal physiology and in reducing the physiological gap between Early and Normal weaned piglets by improving their intestinal integrity



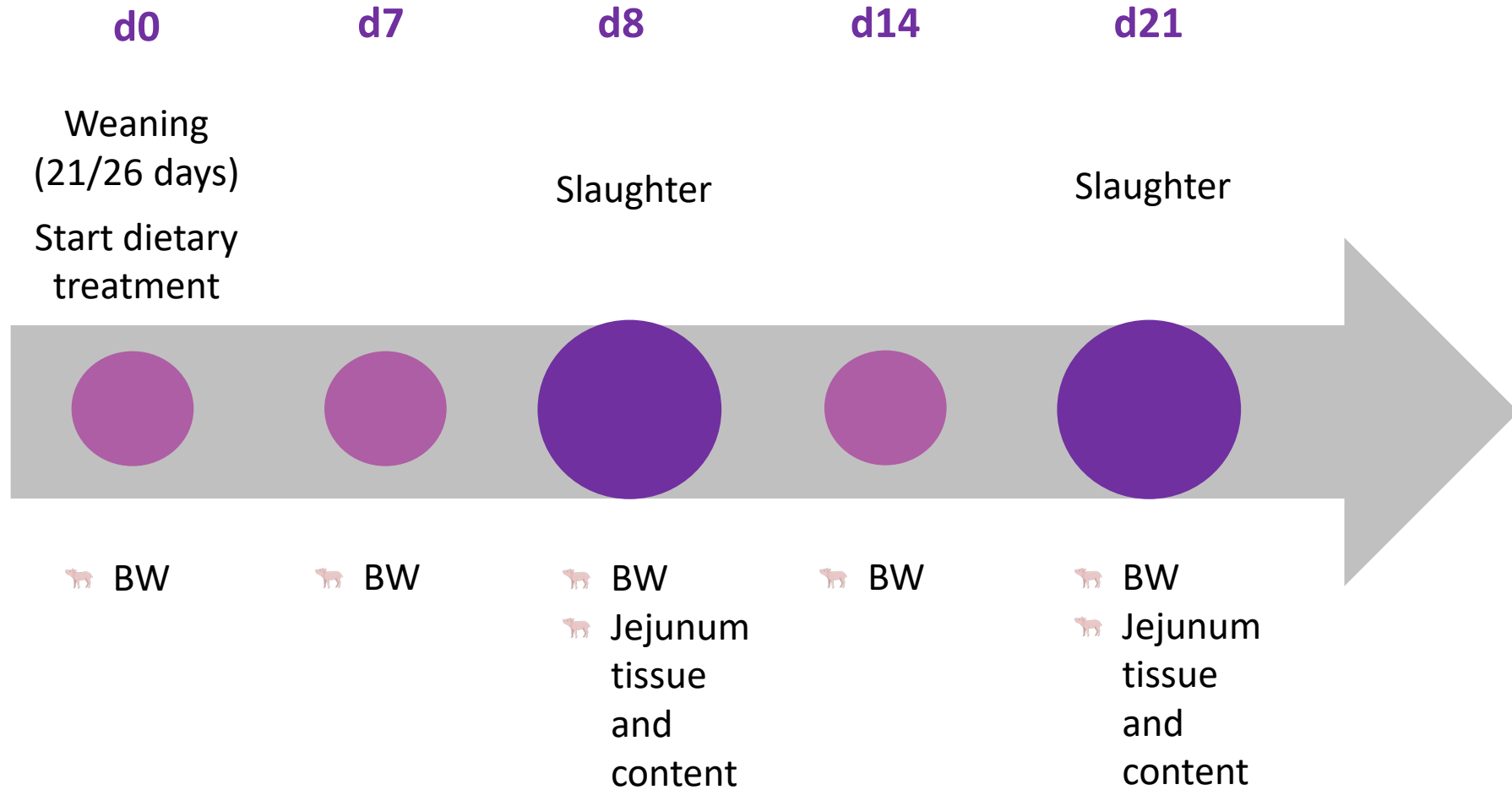
Aim

 The aim of the present study was to determine the effect of a porous form of ZnO compared to an inorganic (ZnSO₄) and organic (Zn-Gly) form of Zn on performance, health status and intestinal mucosal morphology in piglets weaned at either 21 or 26 days of age.

Experimental protocol



Experimental protocol

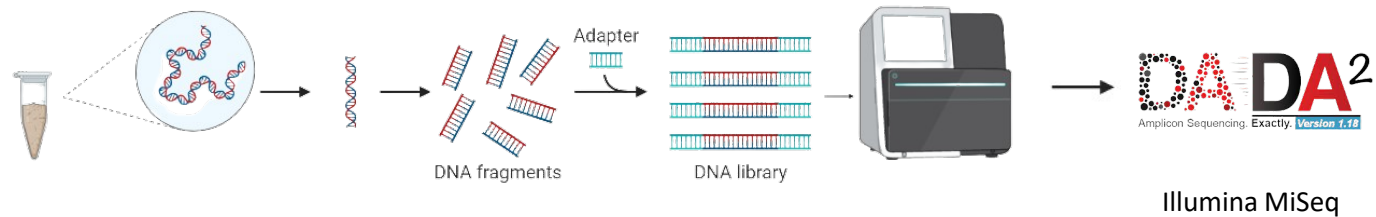


Materials & Methods

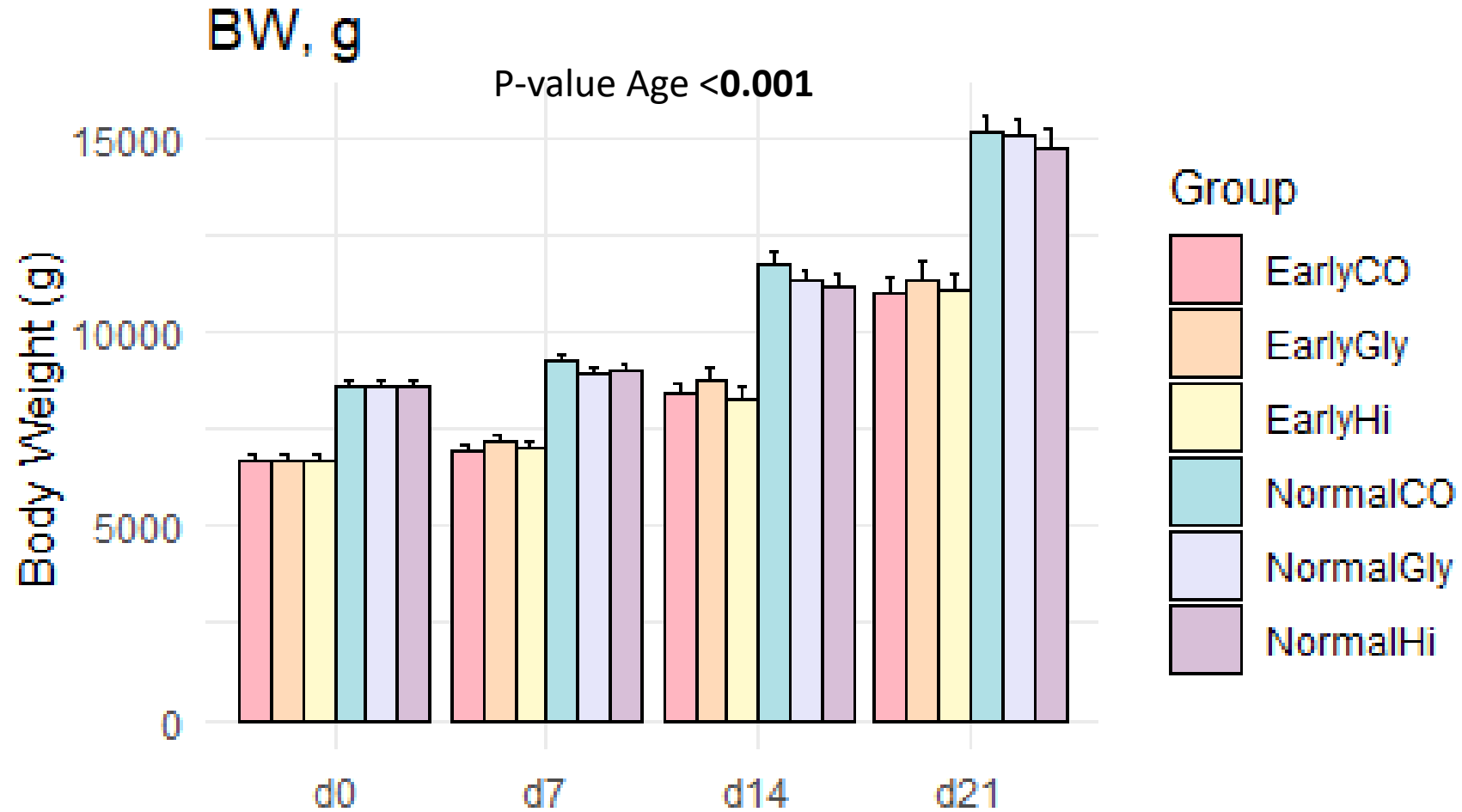
- 🐾 Paraffin thick sections (7 µm) were stained with haematoxylin–eosin for morphological evaluation;
- 🐾 For the microbiota analysis, bacterial DNA extraction of V3-V4 region of 16s rRNA from distal jejunum content

Statistical analysis

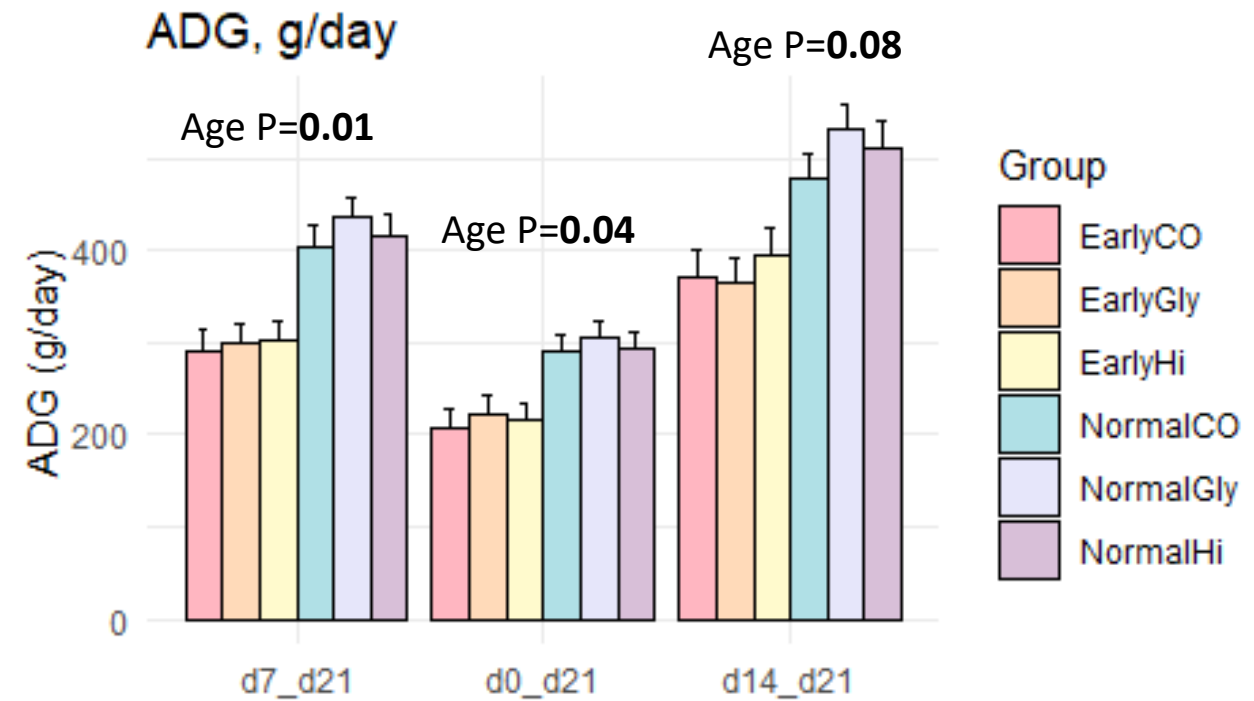
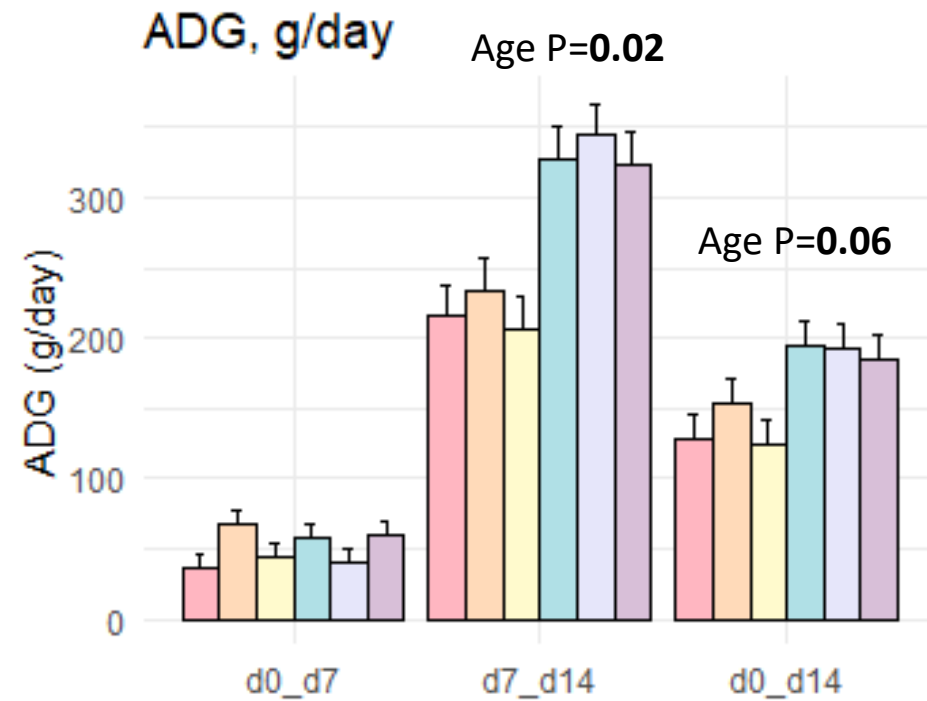
- 🐾 Performance, morphometry, and gene expression $\rightarrow Y \sim \text{Weaning age} + \text{Diet} + \text{Weaning age} * \text{Diet} + 1 | \text{Litter};$
- 🐾 Microbiota $\rightarrow$ Alpha diversity – Beta diversity



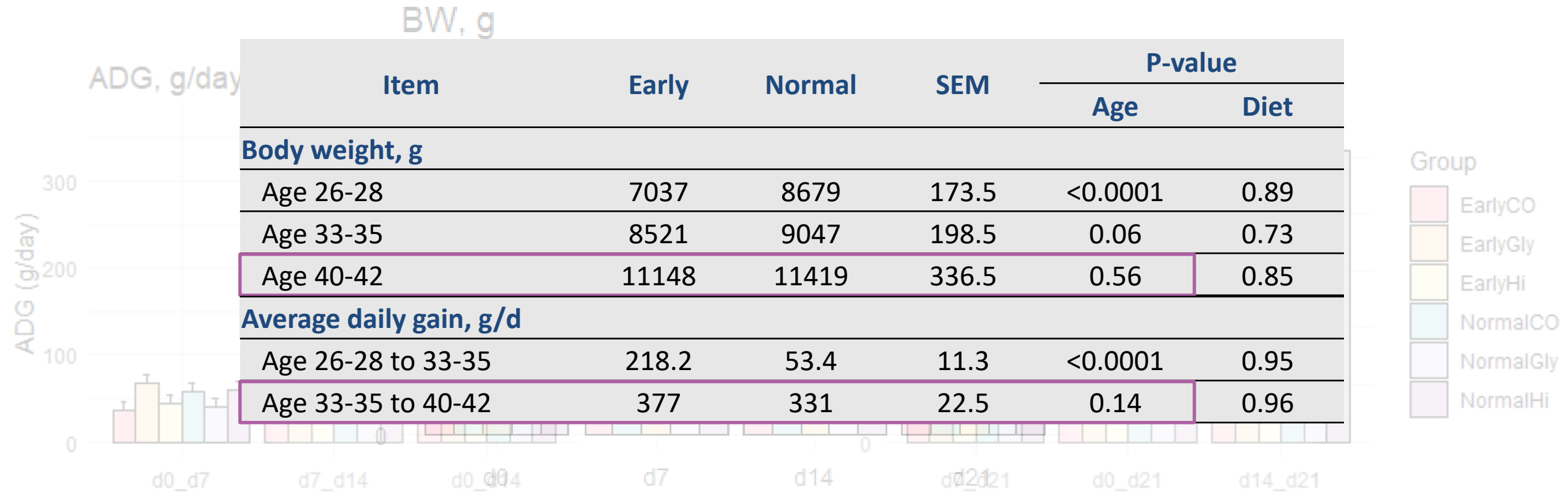
Performance results



Performance results



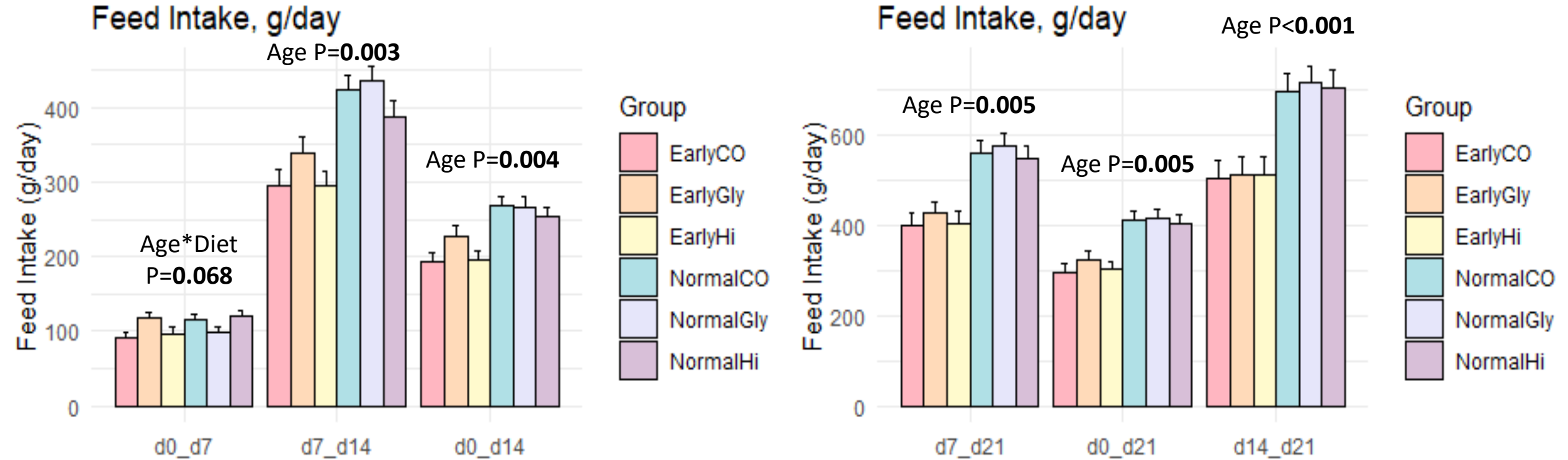
Performance results



The observed variation between the two weaning age classes are merely due to physiological differences associated with the different ages of the piglets



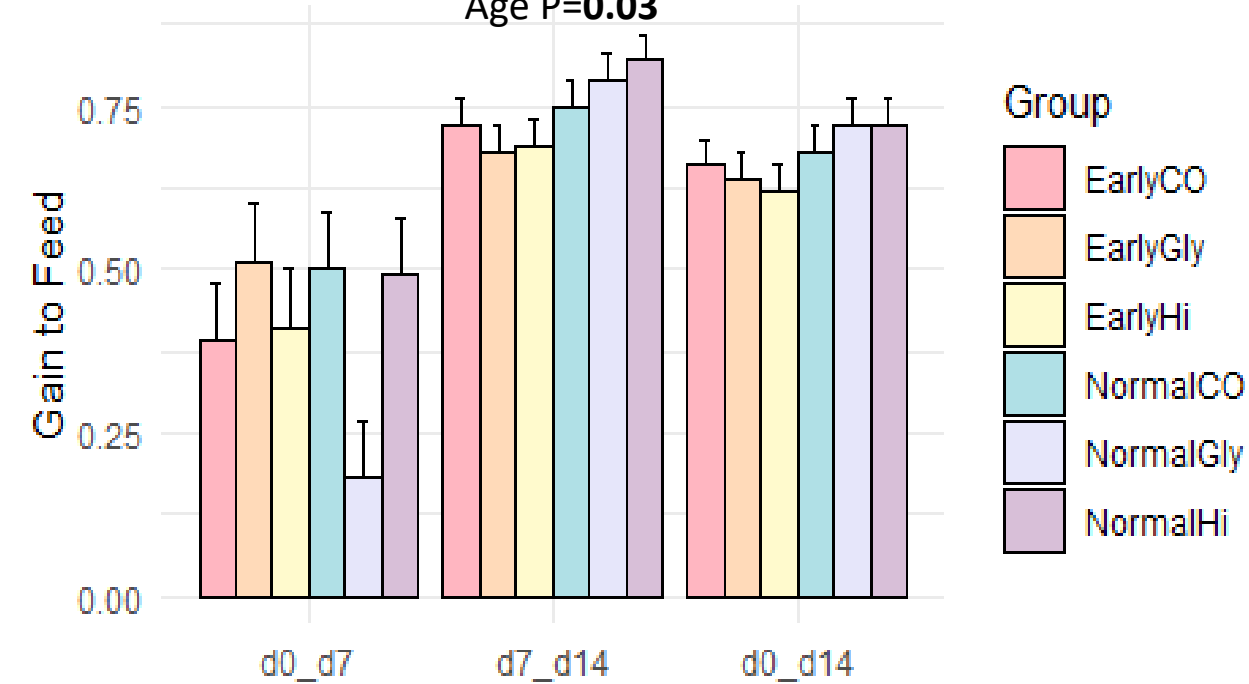
Performance results



Performance results

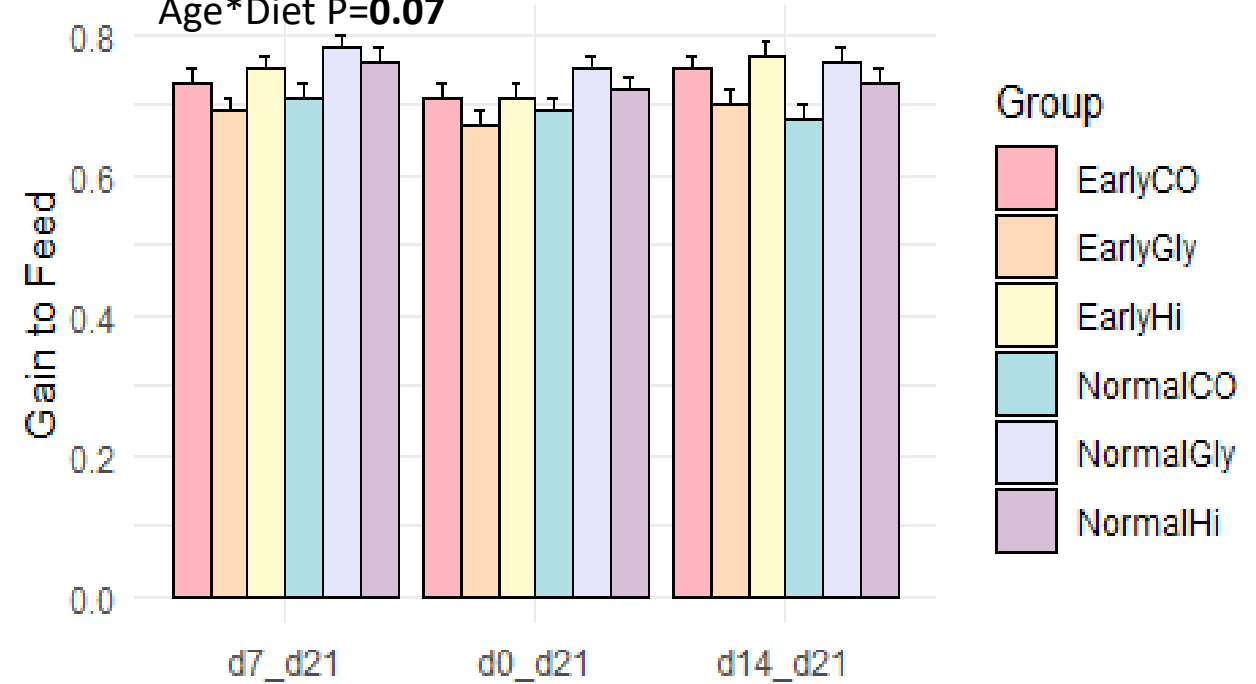
Gain to Feed

Age P=0.03

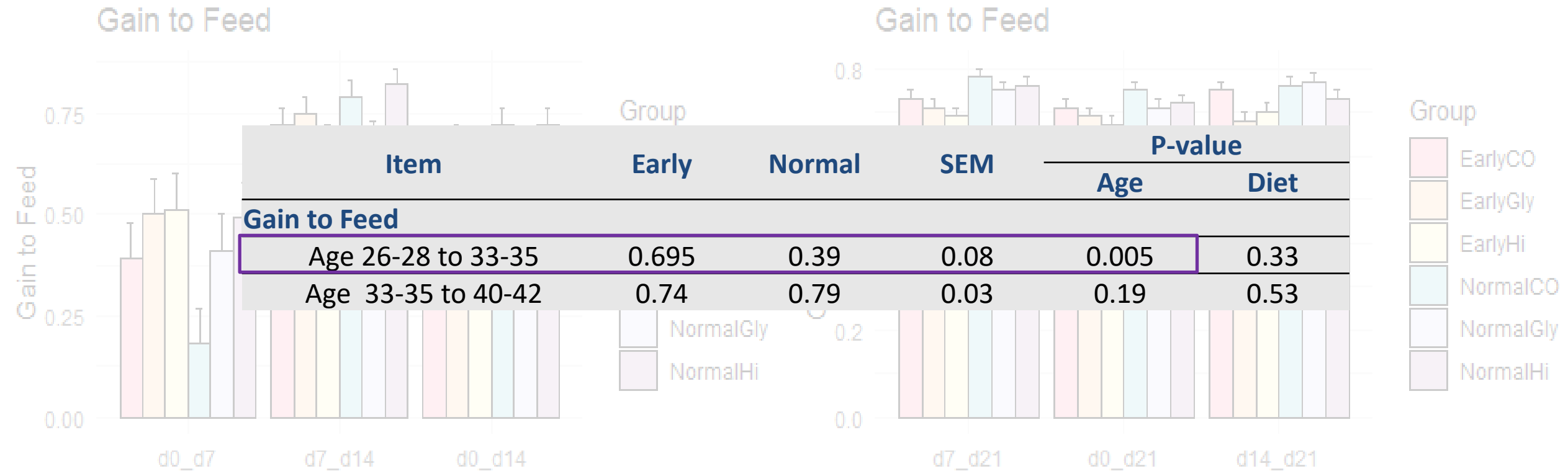


Gain to Feed

Age*Diet P=0.07



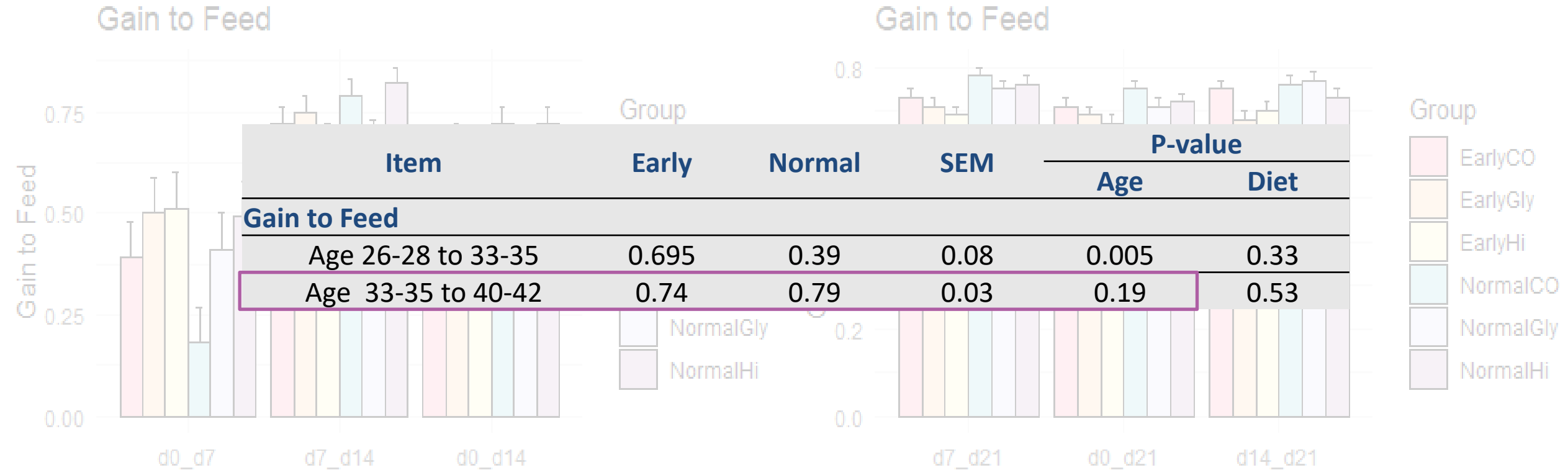
Performance results



G:F was higher in the Early piglets than in the Normal piglets in the second week after weaning. It can be hypothesised that the piglets grew in accordance with their physiological programme



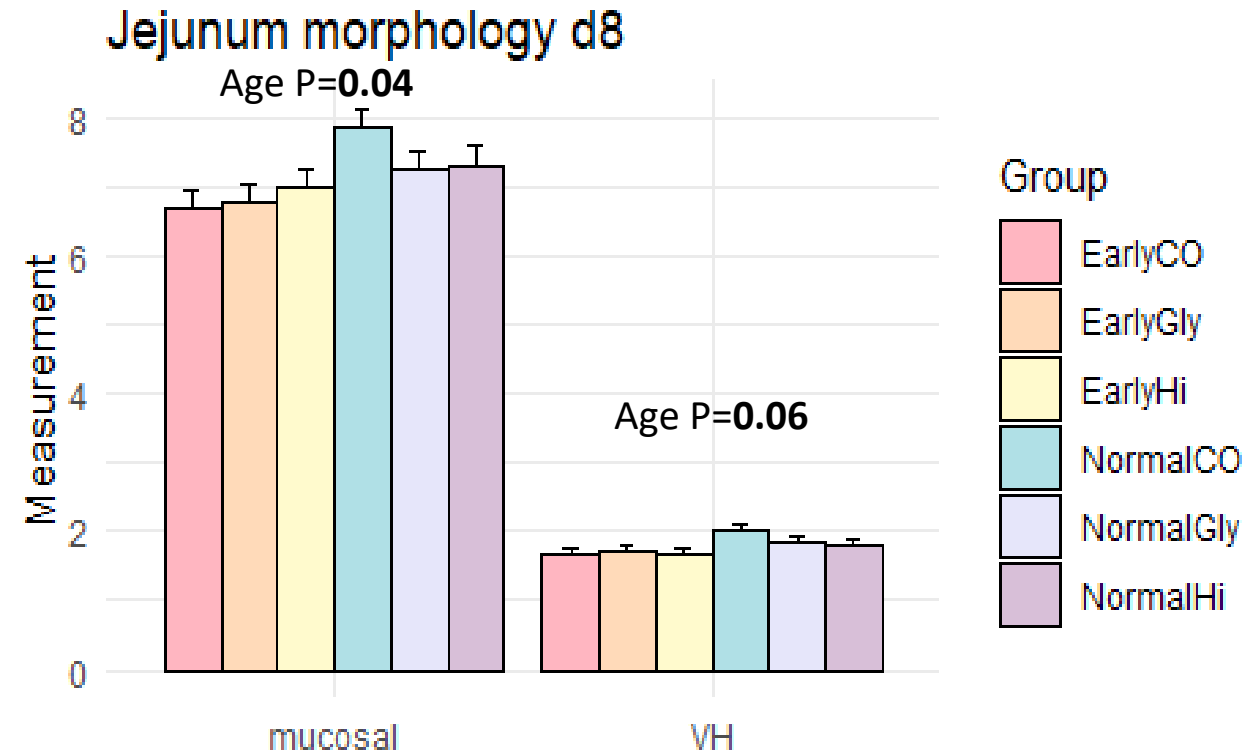
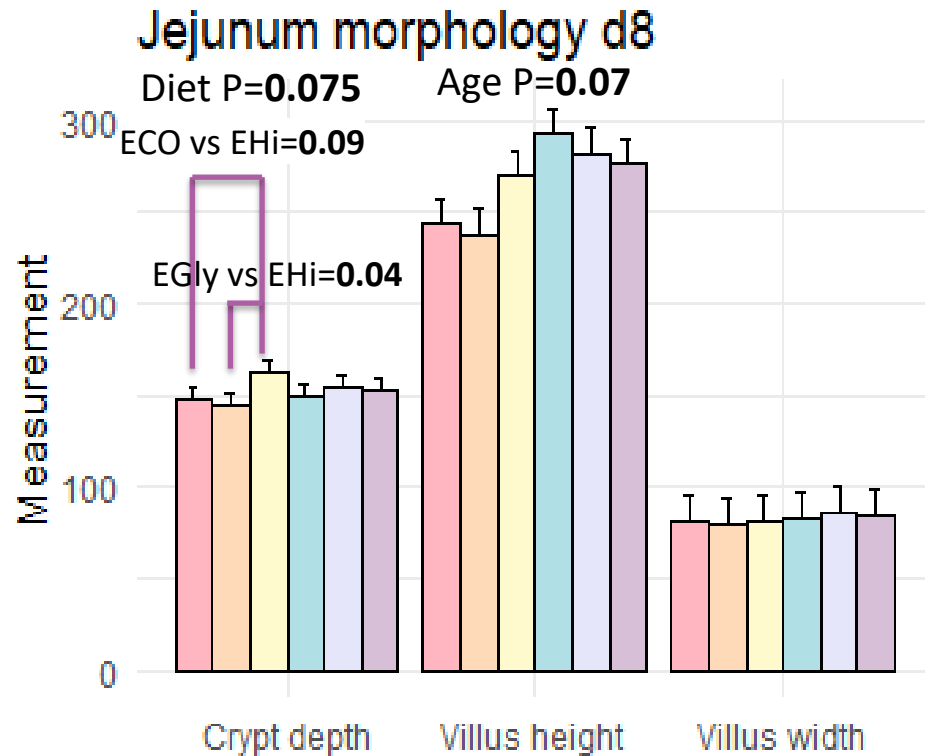
Performance results



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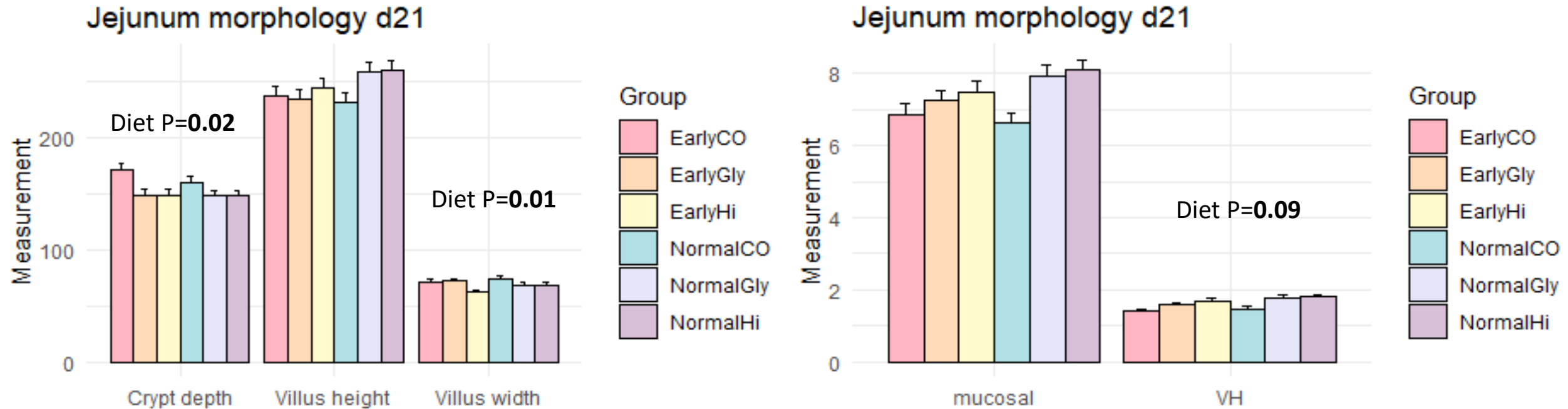
Distal jejunum morphology results d8



The worsen morphological values in Early piglets suggest increased physiological stress related to early weaning



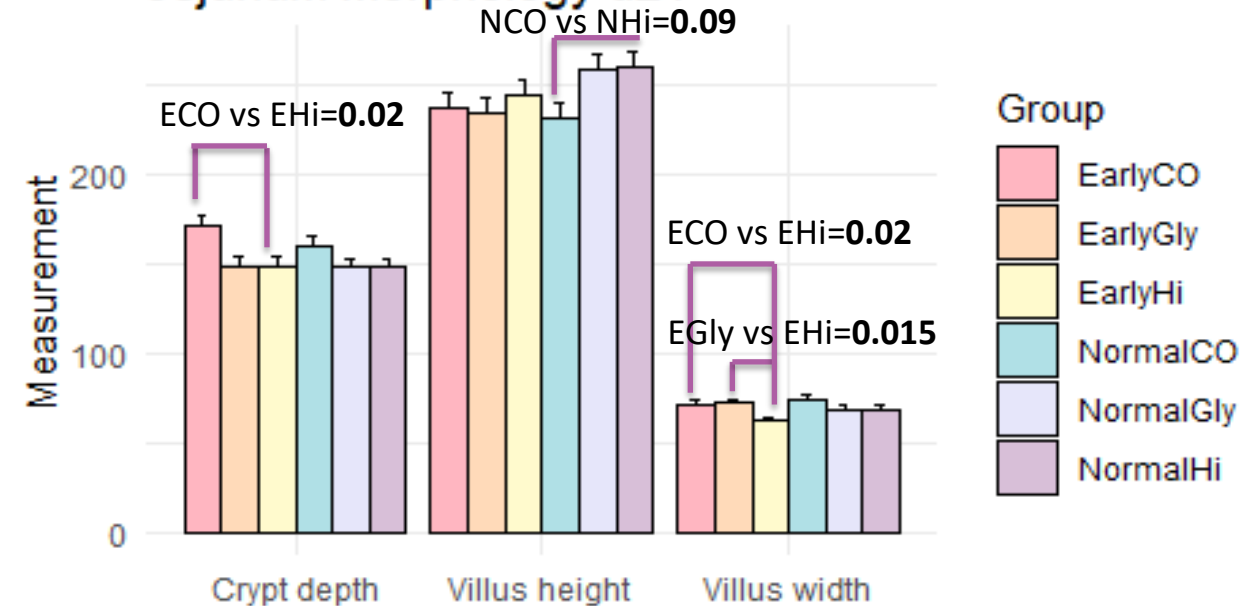
Distal jejunum morphology results d21



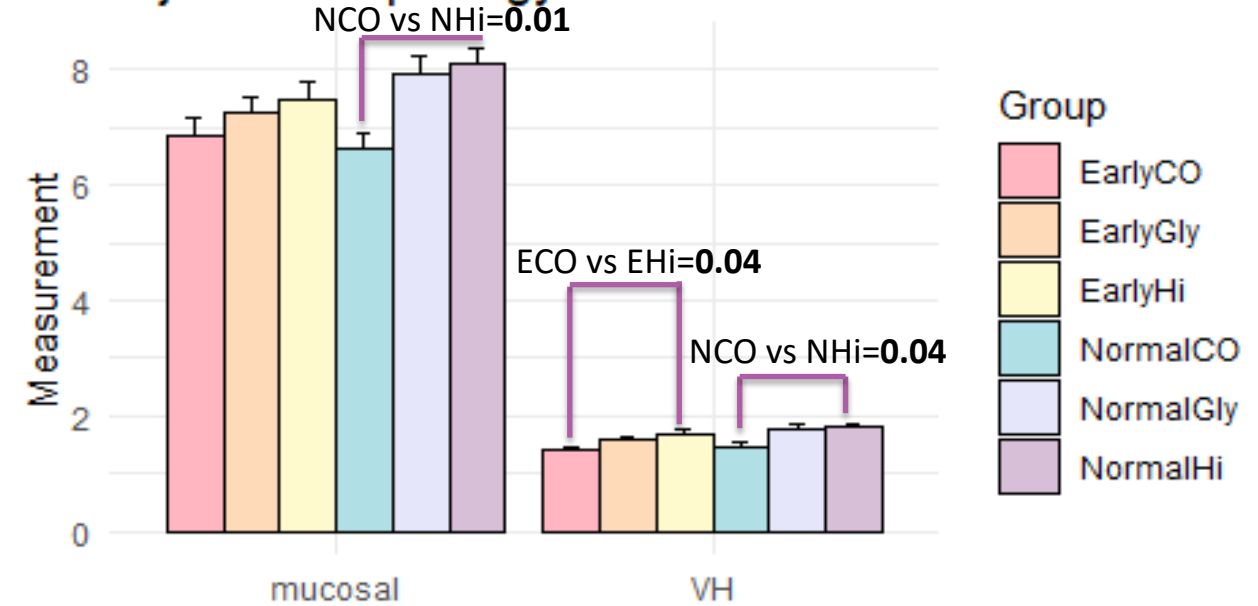
The lack of differences in the jejunal morphology between the Early and Normal piglets may be due to the achievement of the small intestinal maturity even in the Early weaned piglets

Distal jejunum morphology results d21

Jejunum morphology d21



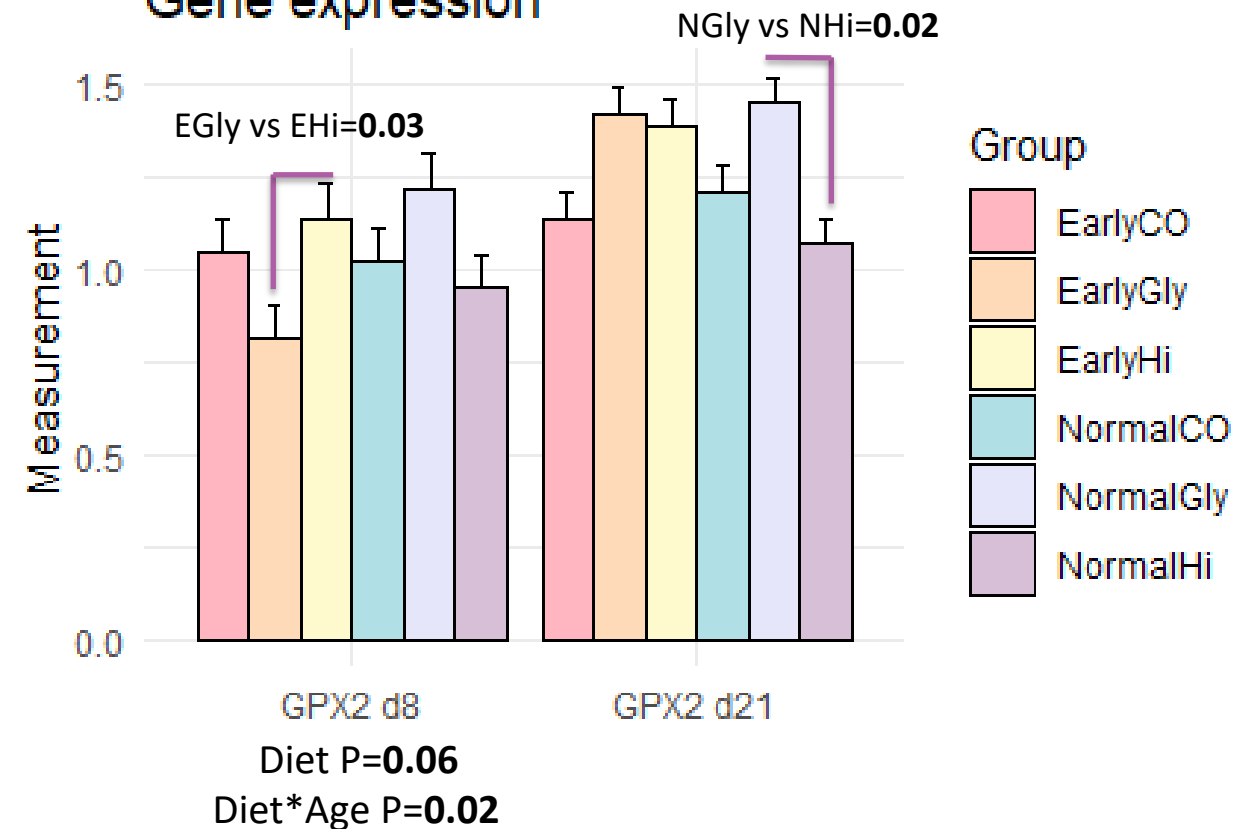
Jejunum morphology d21



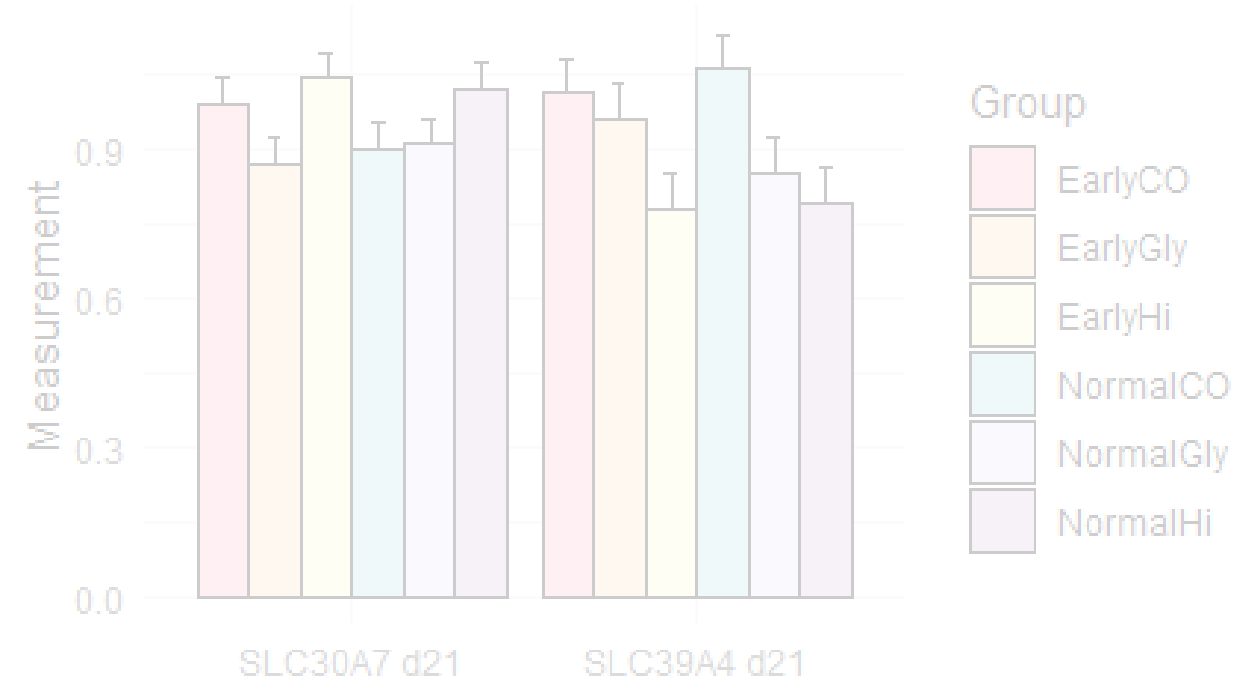
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Distal jejunum mucosa gene expression results

Gene expression



Gene expression

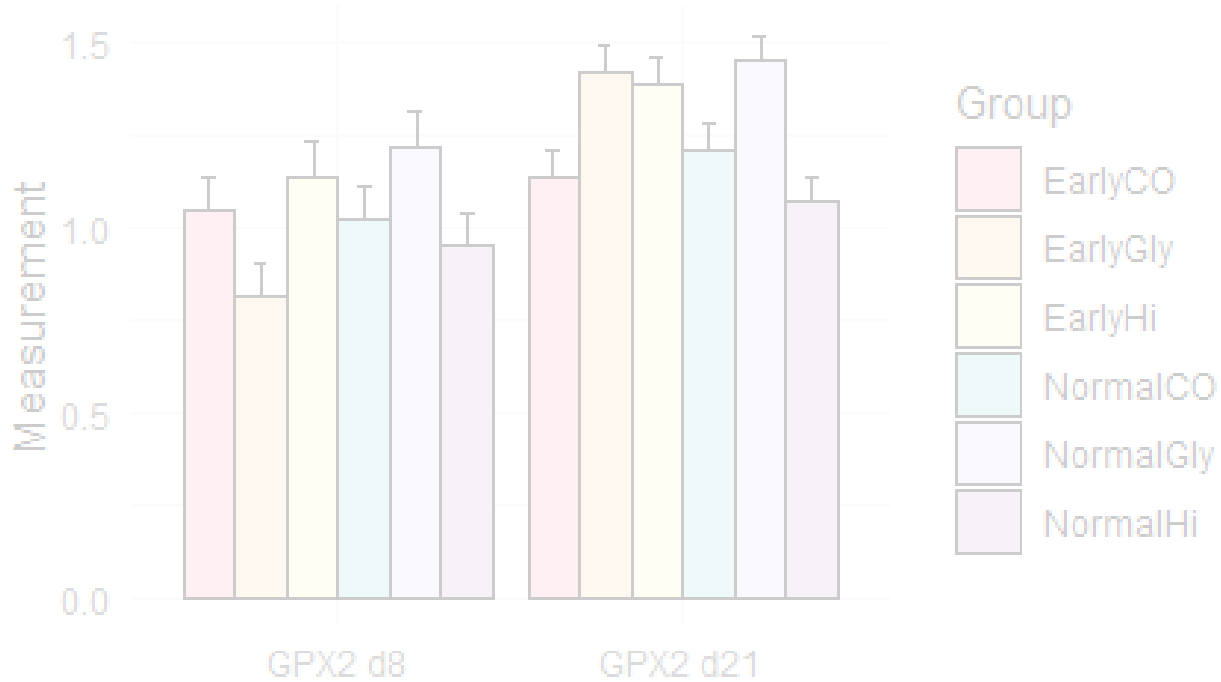


GPX2 plays an important role in maintaining redox homeostasis (Guo et al., 2020)

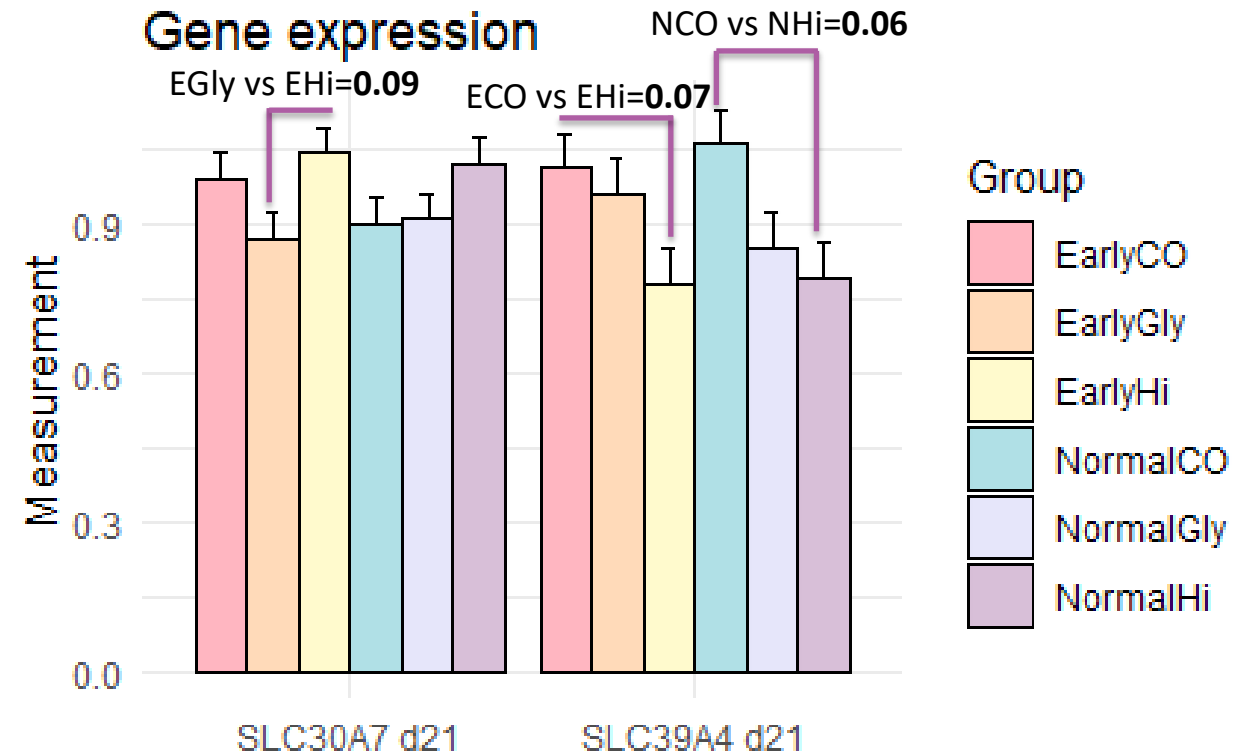


Distal jejunum mucosa gene expression results

Gene expression



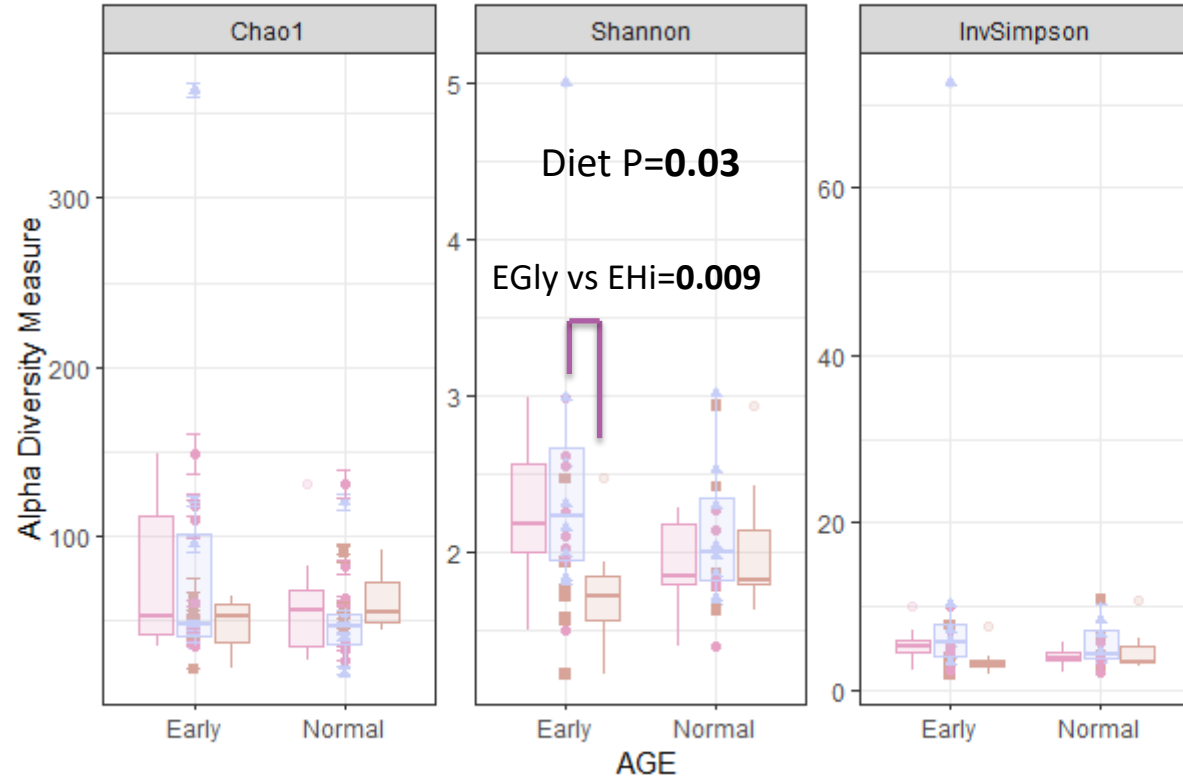
Gene expression



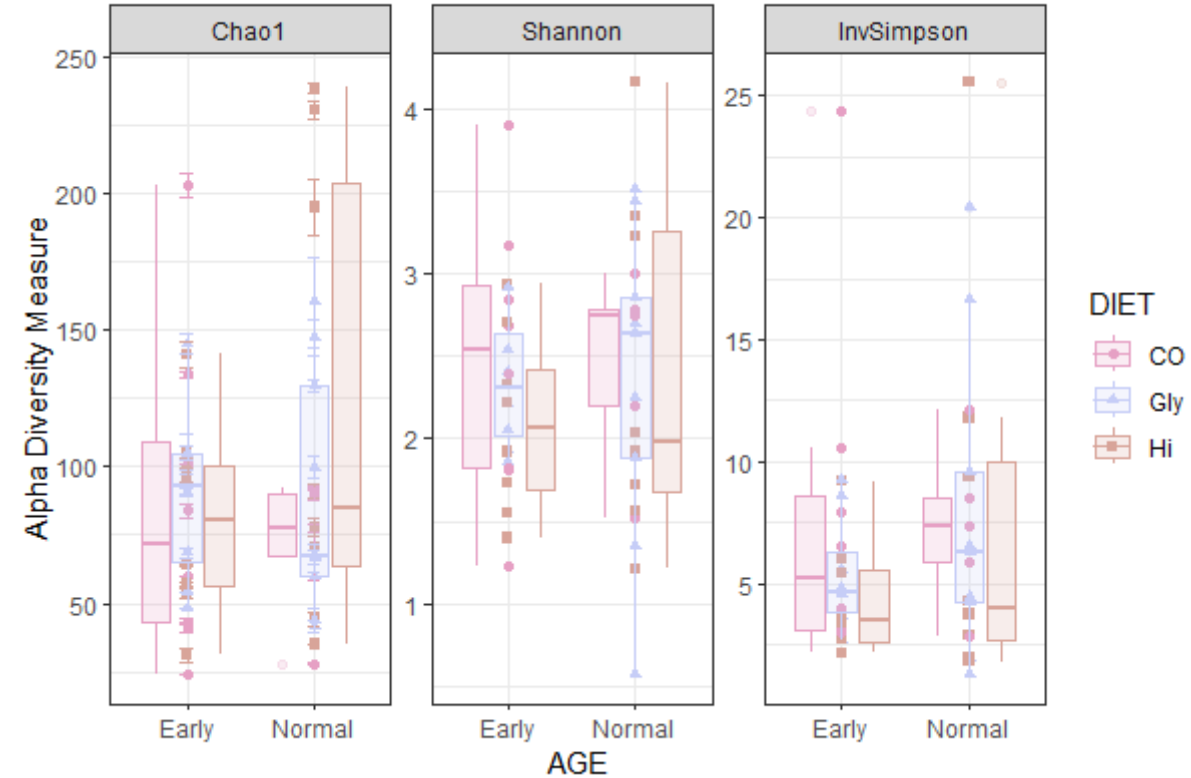
It can be hypothesised that the administration of ZnSO_4 was not as efficient as the porous form of ZnO in meeting the animals' requirements. A trend towards higher expression of *SLC30A7*, the gene that encode for ZnT7 transporter, was observed in EHi compared to EGly

Jejunum content Alpha diversity

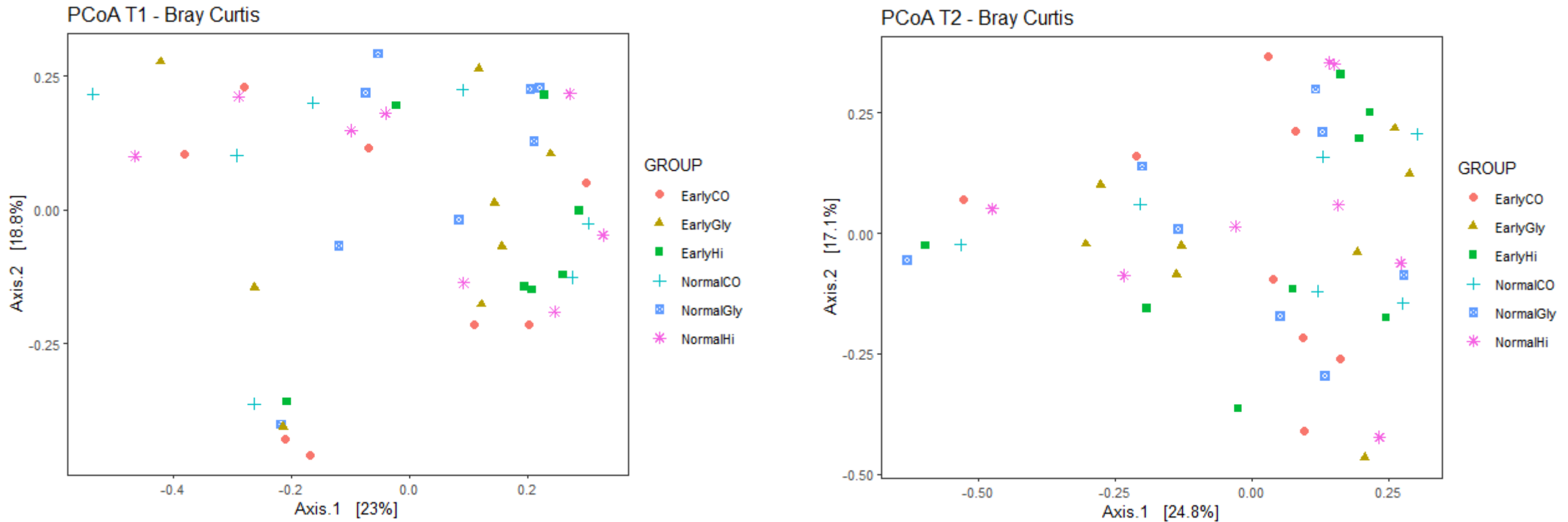
Alpha diversity d8



Alpha diversity d21



Jejunum content Beta diversity



Final considerations

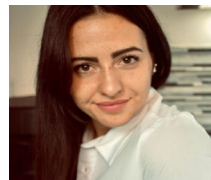
- 🐷 Weaning age was the most impacting variable on the trials results;
- 🐷 Early weaned piglets showed retarded morphological development when compared to Normal weaned piglets one week post-weaning;
- 🐷 Feeding pigs with a porous form of ZnO resulted in enhanced morphological parameters two weeks after weaning, regardless the age at weaning;
- 🐷 The HiZox® could contribute to reduce the detrimental effect of weaning on gut homeostasis, therefore it can be considered as a strategy to ameliorate the negative weaning consequences.





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