FACULTY OF BIOSCIENCE ENGINEERING

ARTIFICIALLY REARED PIGLETS EXHIBIT GUT DYSFUNCTION AT MATERNAL SEPARATION AND AT WEANING

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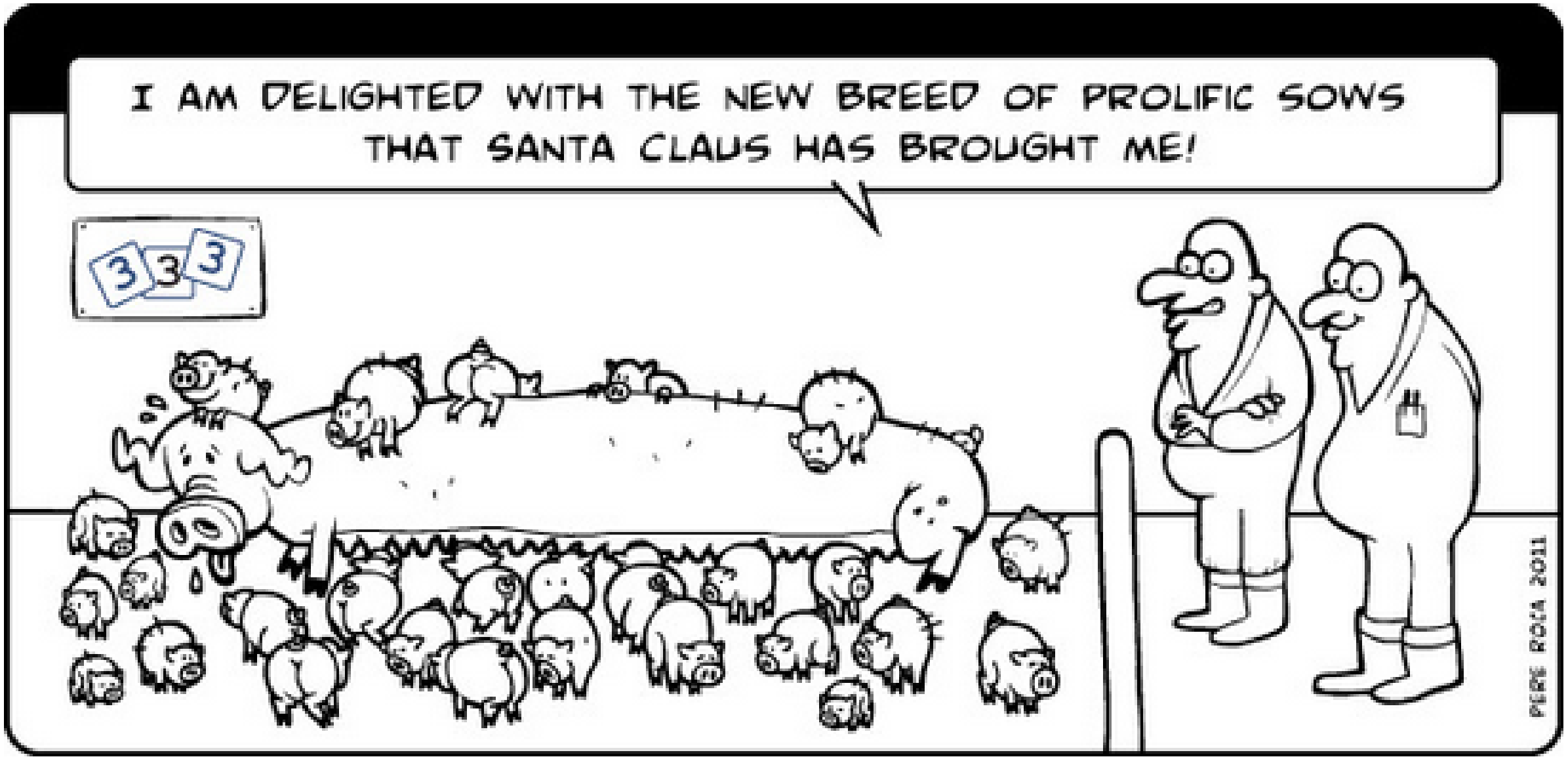
I AM DELIGHTED WITH THE NEW BREED OF PROLIFIC SOWS THAT SANTA CLAUS HAS BROUGHT ME!
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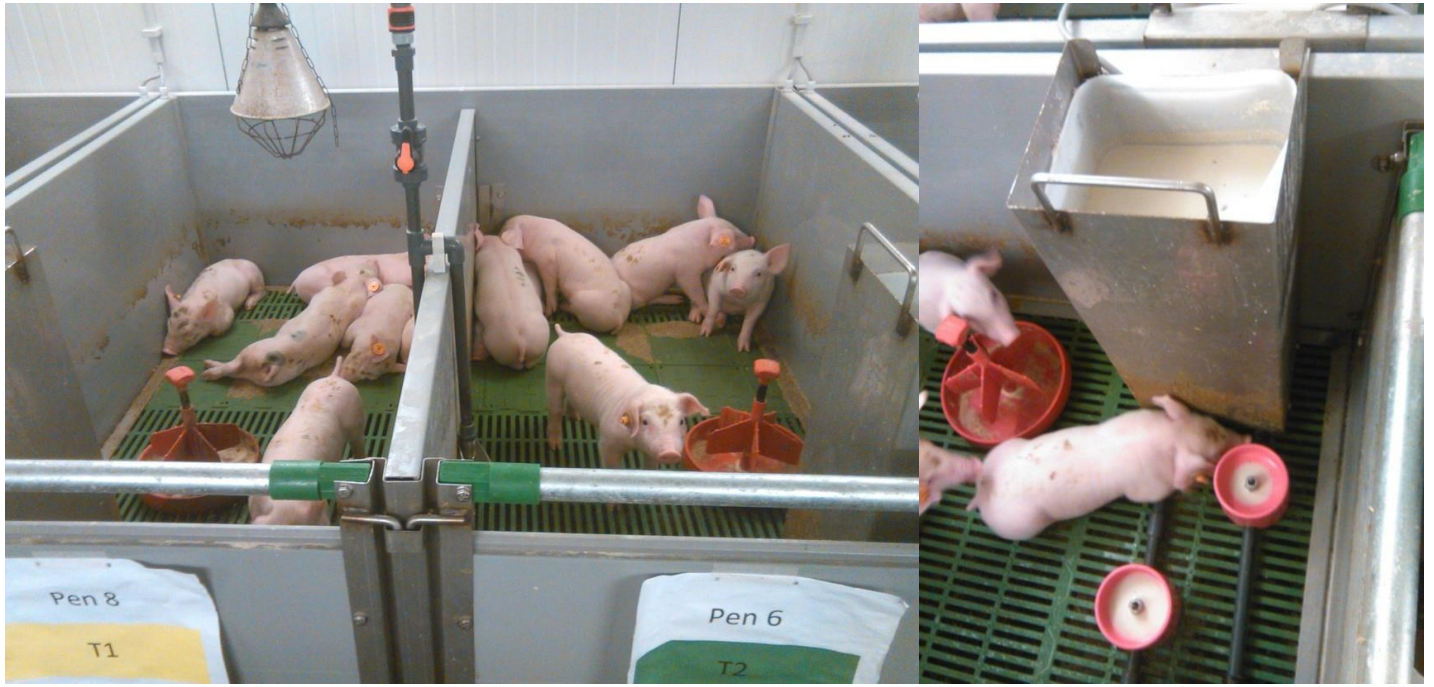
PERE ROCA 2011

Pig333.com

ARTIFICIAL REARING OF SUPERNUMERARY PIGLETS

- Maternal separation at a young age (at 3 to 6 days of age)
- Feeding a milk replacer *ad libitum* through a cup system until 16 to 21 days of age



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OBJECTIVES

Determine the impact of artificial rearing on:

- Small intestinal histo-morphology
- Small intestinal barrier function

Study long-term effects (4 week follow-up)

Study the impact of birth weight

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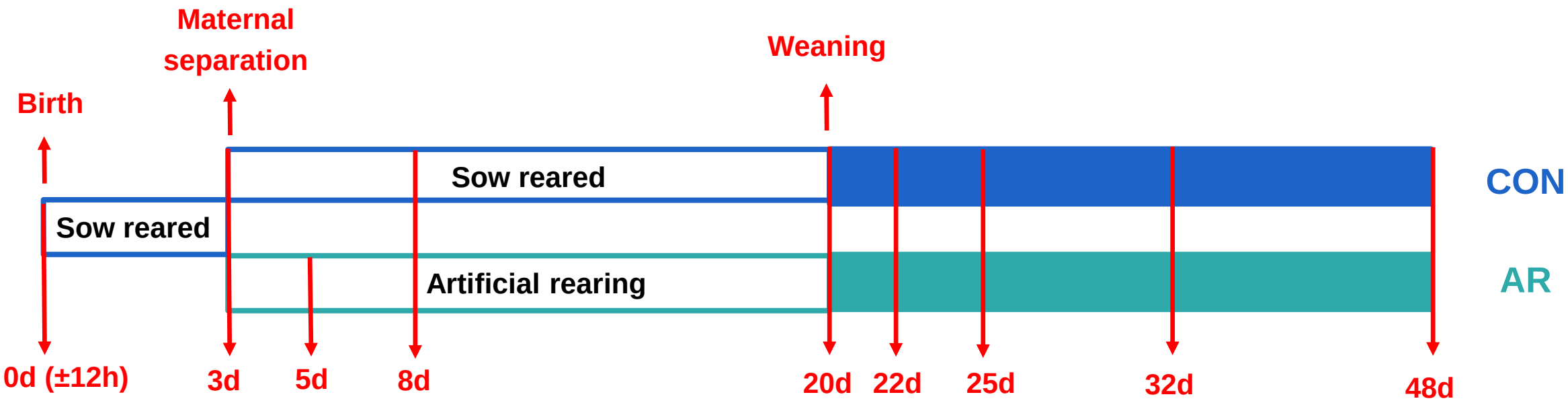
EXPERIMENTAL SETUP

- Selection at birth:
  - Normal birth weight (**NBW**) piglet: **[mean - 0.5 x SD; mean + 0.5 x SD]**
  - Low birth weight (**LBW**) littermate: **[0.75; 0.90] and lower quartile of the litter**
- Pairs of NBW and LBW littermates allocated to conventional (CON) or artificial rearing (AR) and sampling at different days
- 12 piglets per sampling time point per treatment, 6 NBW and 6 LBW
- Executed in 8 consecutive rounds



FEEDING PROTOCOL

- *Ad libitum* milk replacer from 3d to 20d of age
- Daily milk preparation by mixing 4kg water + 1kg milk powder
- Milk replacer containing 4% spray dried blood plasma

- Creep feed for CON but not AR piglets

- Same weaner diet *ad libitum* for CON and AR from 20d to 48d of age (d0-28 post-weaning)

Calculated nutrient levels[1]	Milk replacer	Weaner diet
NEv(1997) MJ/kg	15.48	9.8
CP (g/kg)	249	173
CF (g/kg)	110	73
dLYS (g/kg)	18.2	11
dMET+CYS (g/kg)	11.5	6.6
dTHR (g/kg)	11.2	6.7
dTRY (g/kg)	4.1	2.2

The premix supplied (/kg diet): vitamin A, 30 000 IU; Vitamin D3, 5000 IU; Vitamin E; 75 mg ; Fe^{2+}, 120 mg Zn^{2+}, 35 mg ; Cu^{2+}, 135 mg; Mn^{2+}, 45 mg; Se^{6+}, 350 µg ; I^-, 1 mg, BHT, 75 mg/kg. The premix supplied (/kg diet): vitamin A, 15 000 IU; Vitamin D3, 2000 IU; Vitamin E; 100 IE Vitamin K3, 2,5 mg; vitamin B1, 0,8 mg; vitamin B2, 5,6 mg; vitamin B6, 0,8 mg ; vitamin B12, 26 µg; Niacine, 38 mg ; Folic acid, 0.4 mg; Fe^{2+}, 150 mg Zn^{2+}, 115 mg; cu^{2+}, 160 mg; Mn^{2+}, 34 mg; Se^{6+}, 250 µg ; I^-, 480 µg, BHT, 13,6 mg; Propylgalate, 37.7 mg; Ethoxyquin, 1,92 mg; Phytase (EC3.1.3.26), 540 FTU; Xylanase (3.2.1.8), 70 AXC; Glucanase (EC3.2.1.6). [1] According to Centraal Veevoeder Bureau (1997), The Nederlands [266].

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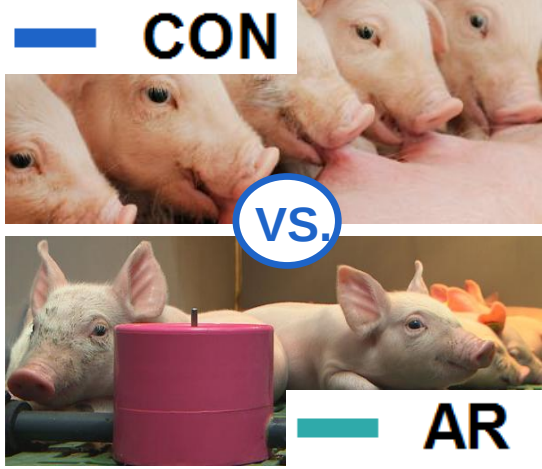
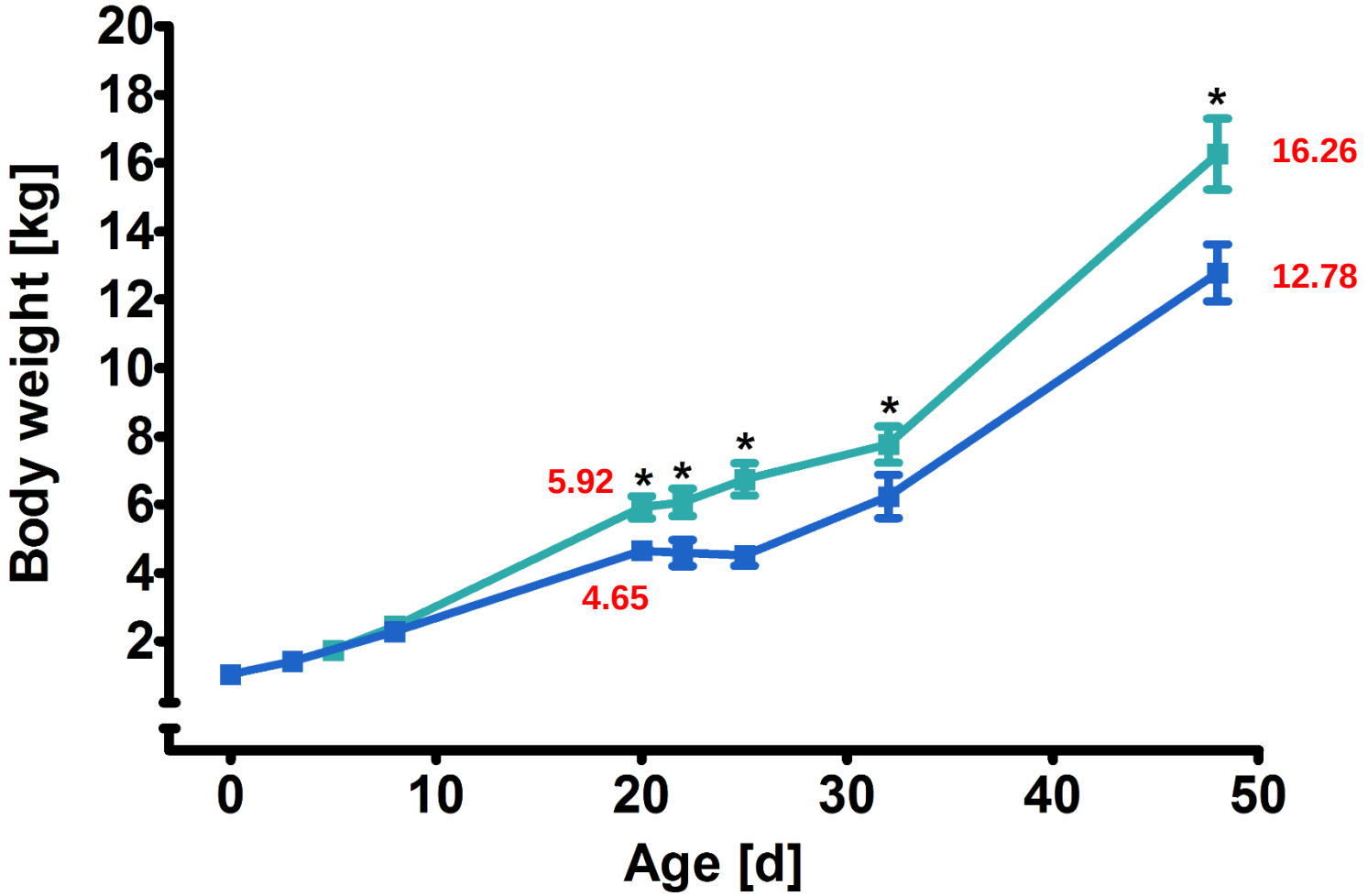
GROWTH PERFORMANCE

- AR piglets outperformed CON piglets from 20d of age onwards ($p < 0.05$)
- No accurate data were gathered on milk/feed intake and efficiency





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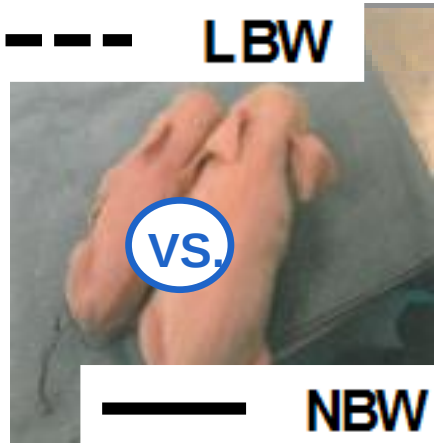
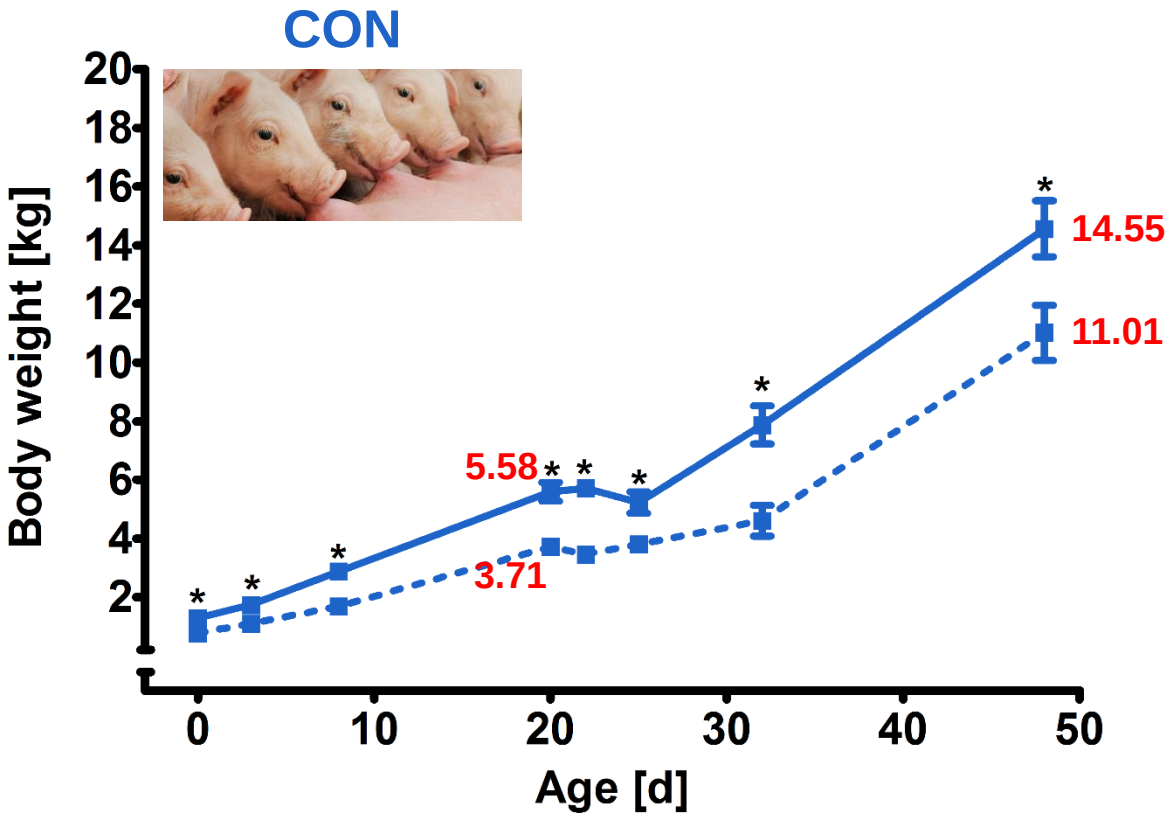
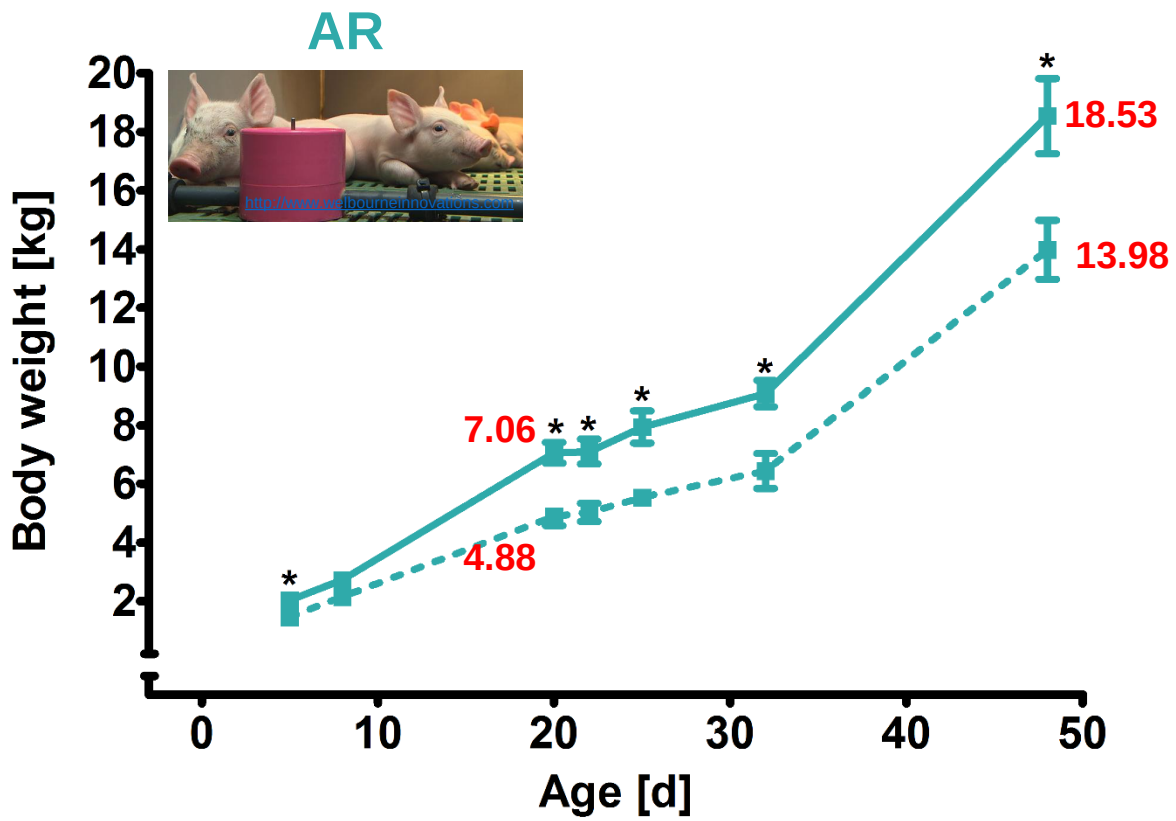
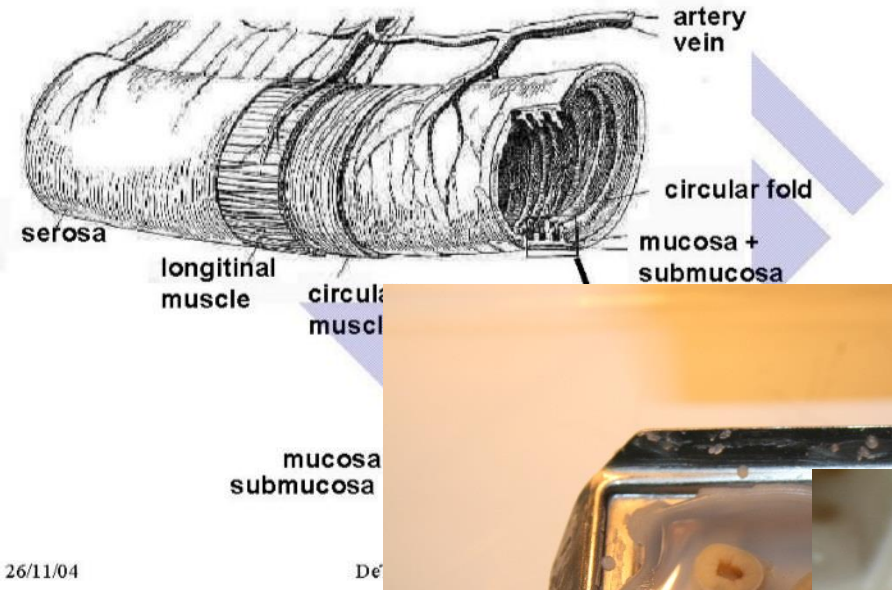
GROWTH PERFORMANCE

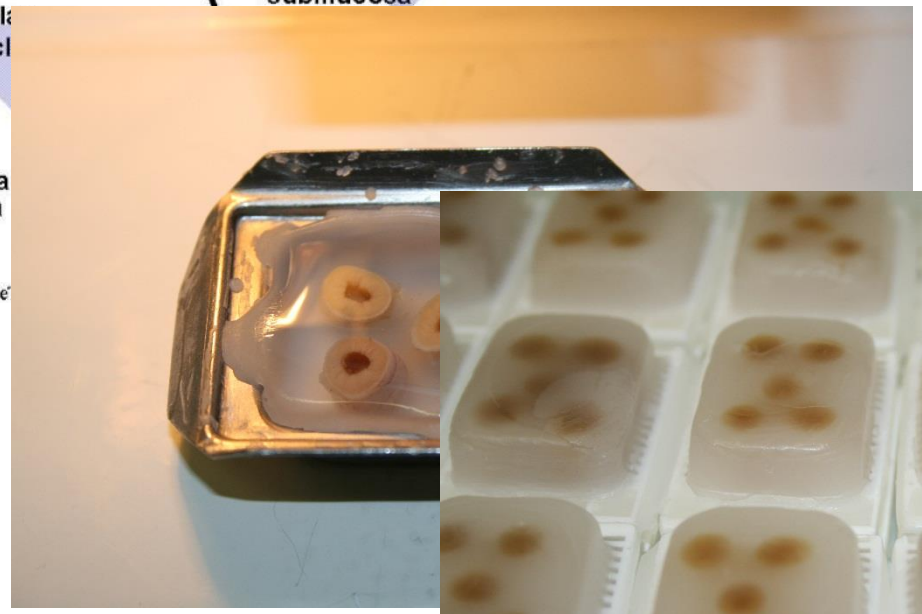
- LBW remained smaller then NBW throughout the experiment
- NBW and LBW AR heavier than NBW and LBW CON, respectively (d48; n =6; $p < 0.05$)

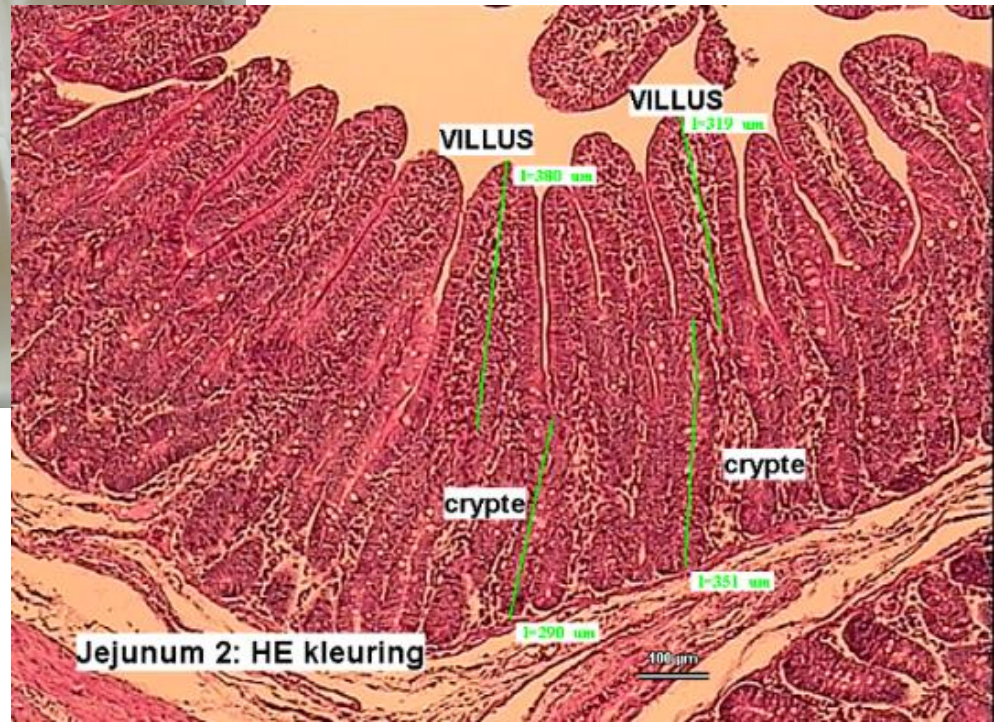












Assessing villus length, width and crypt depth in the distal jejunum, **at 75% of the total small intestinal length**

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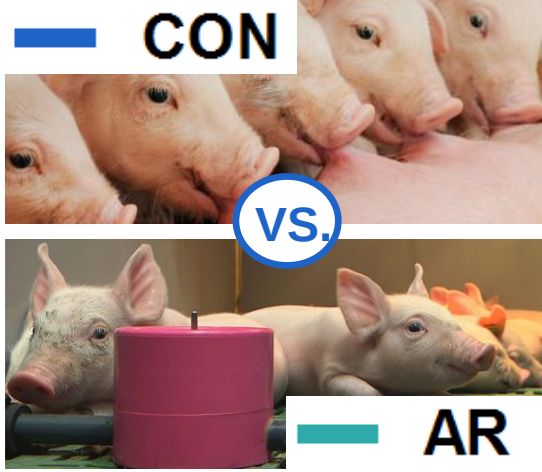
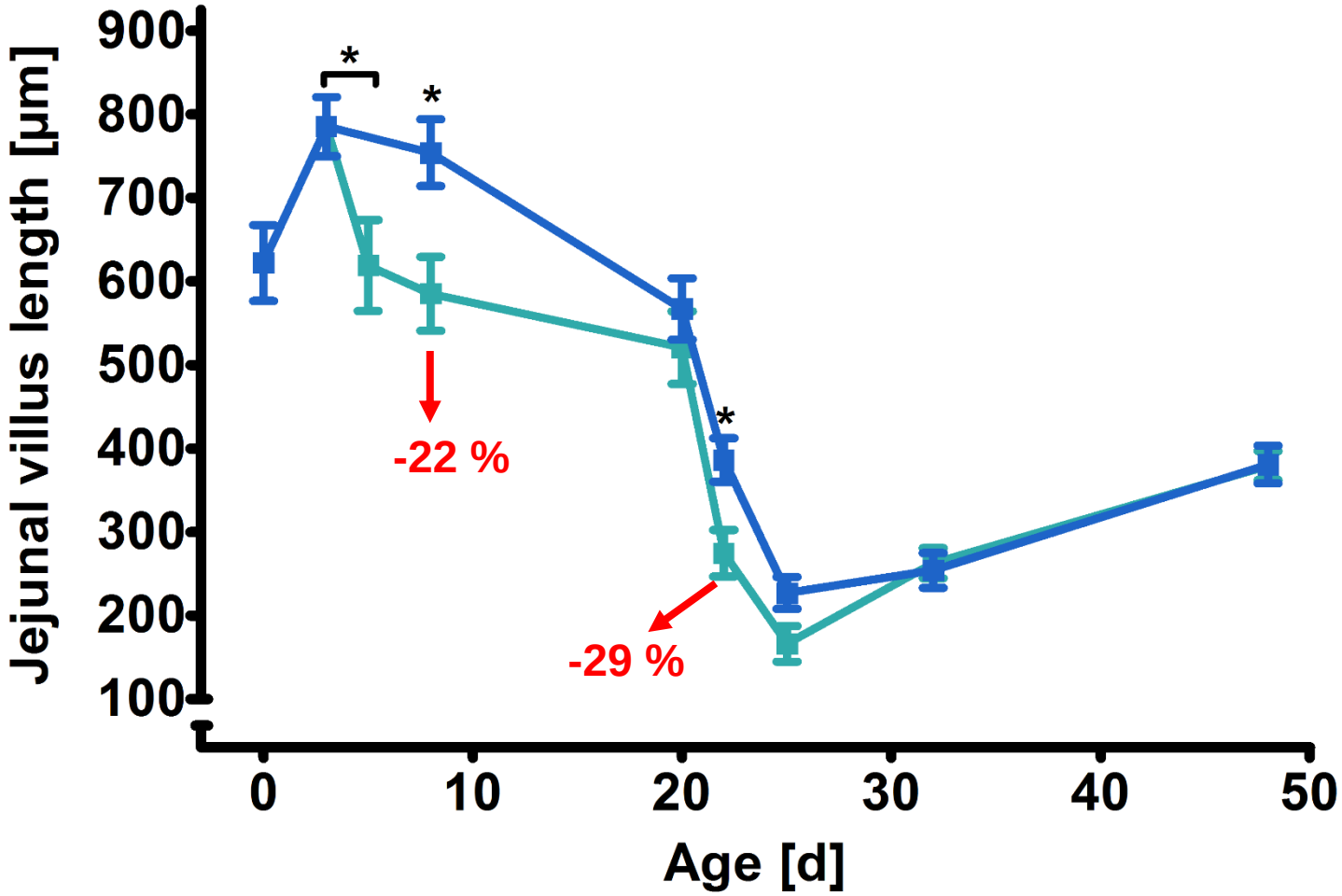
JEJUNAL HISTO-MORPHOLOGY

- Villus atrophy occurred upon maternal separation in AR piglets
- Villi were smaller in AR piglets at d2 post-weaning (n=12; $p < 0.05$)





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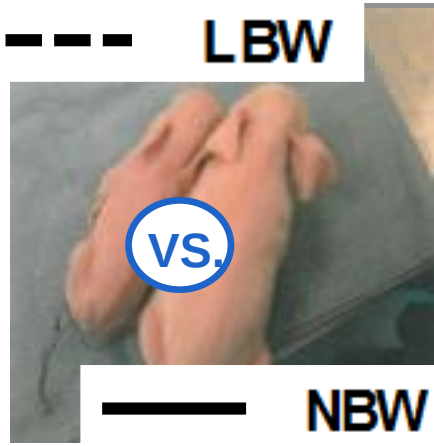
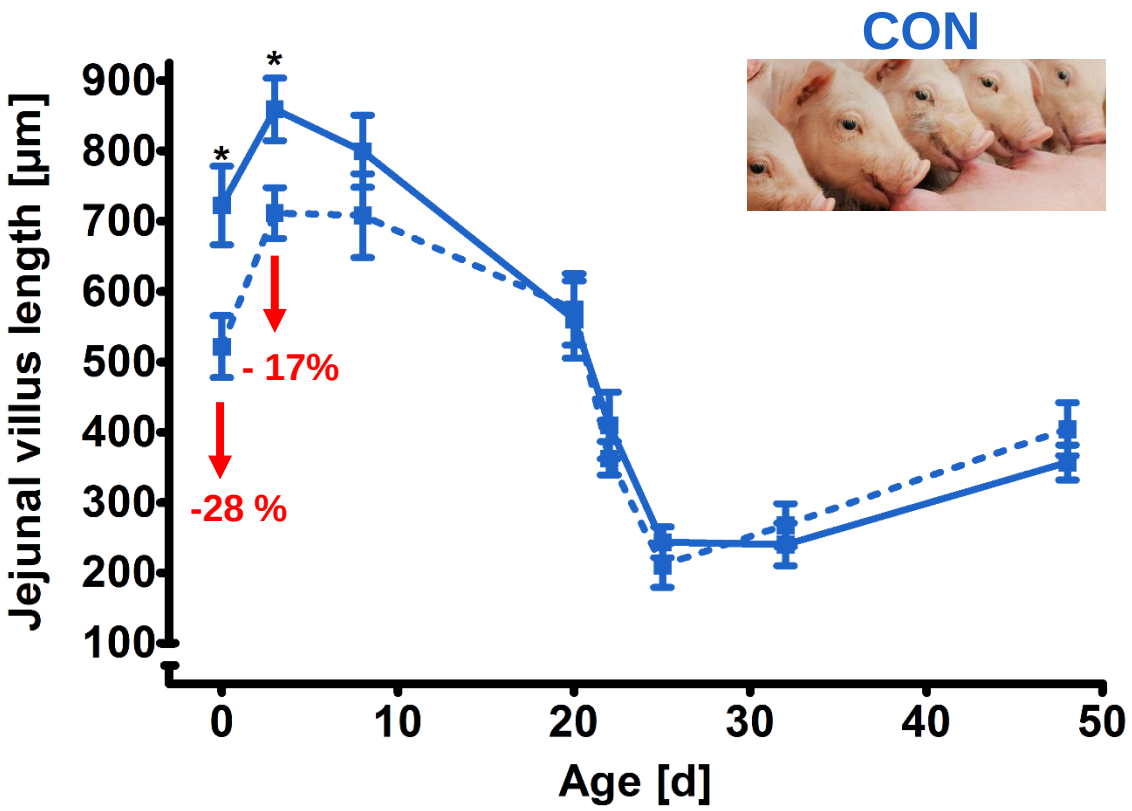
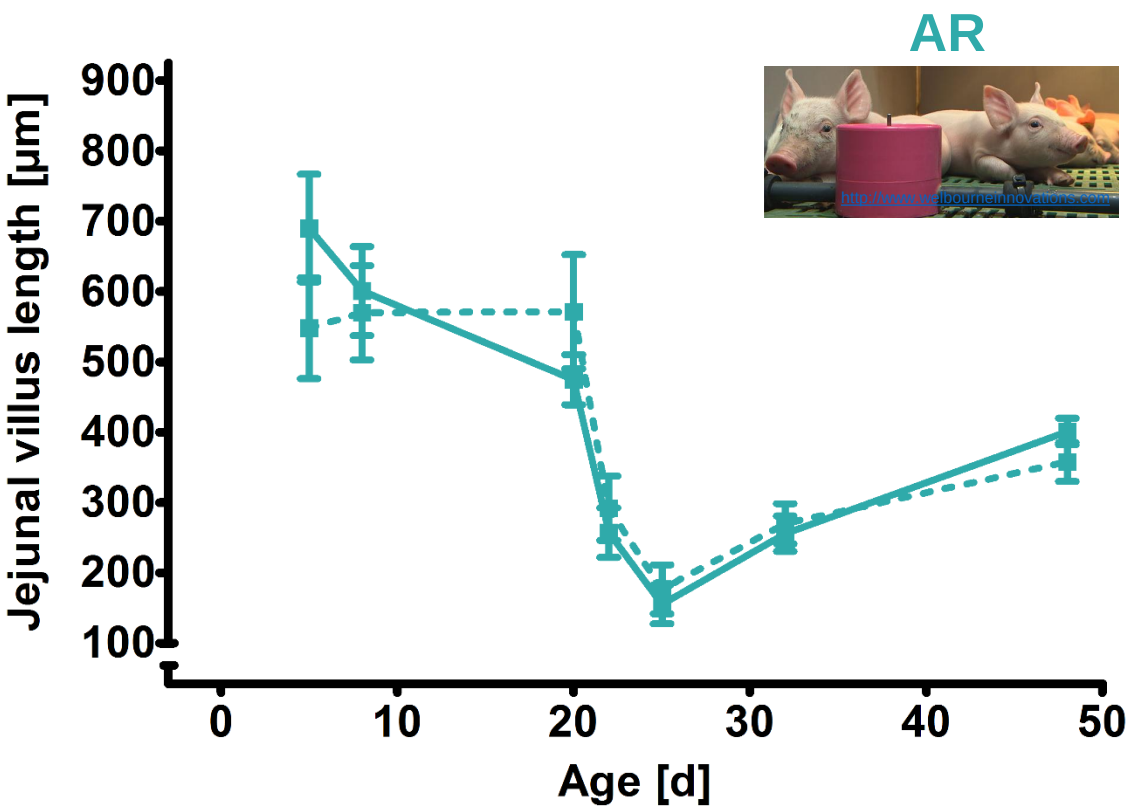
JEJUNAL HISTO-MORPHOLOGY

- LBW had smaller villi at 0d and 3d of age (n=6; $p < 0.05$)
- LBW did not differ from NBW beyond 3d of age, both for CON and AR (n=6; $p > 0.05$)

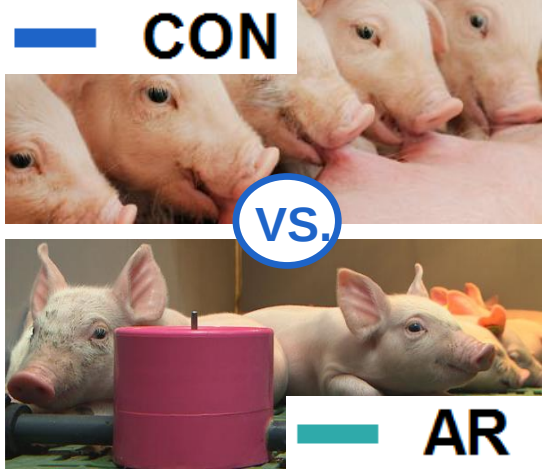


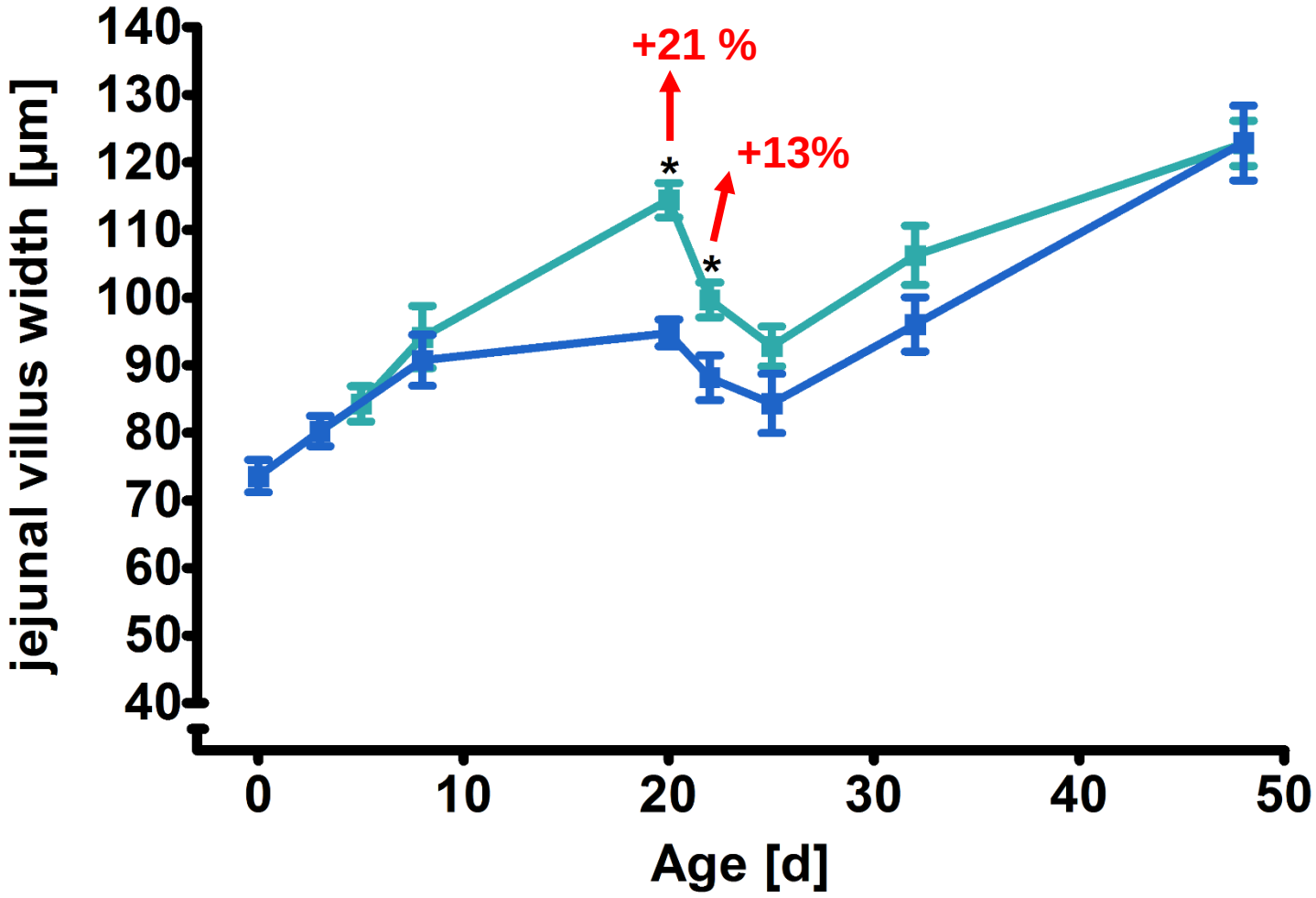




JEJUNAL HISTO-MORPHOLOGY

- Wider villi at 20d and 22d of age in AR piglets (n=12; $p < 0.05$)
- LBW and NBW showed an almost identical pattern (n=6; $p > 0.05$)





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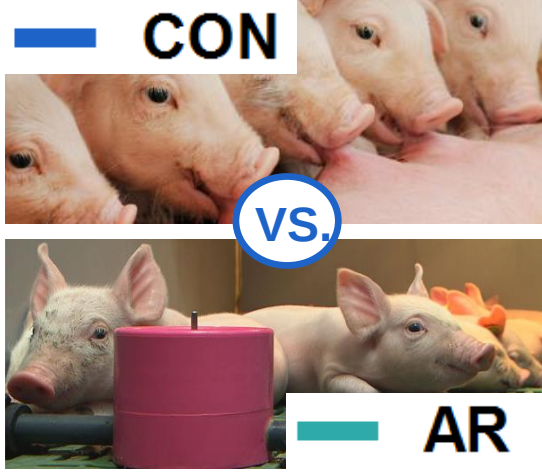
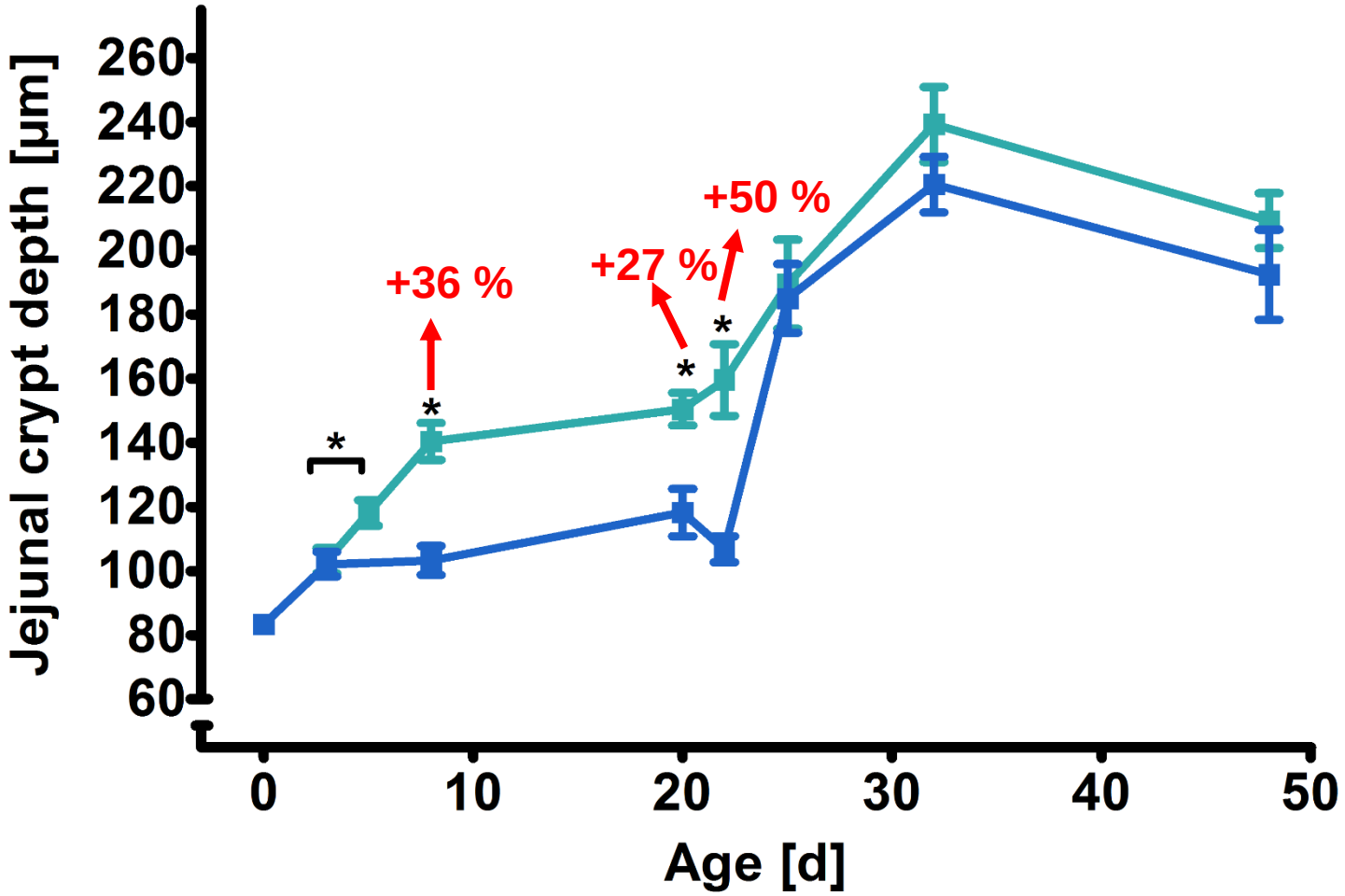
JEJUNAL HISTO-MORPHOLOGY

- AR increased crypt depth until d22 of age (d2 post-weaning) (n=12; $p < 0.05$)
- LBW and NBW showed an identical pattern (n=6; $p > 0.05$)





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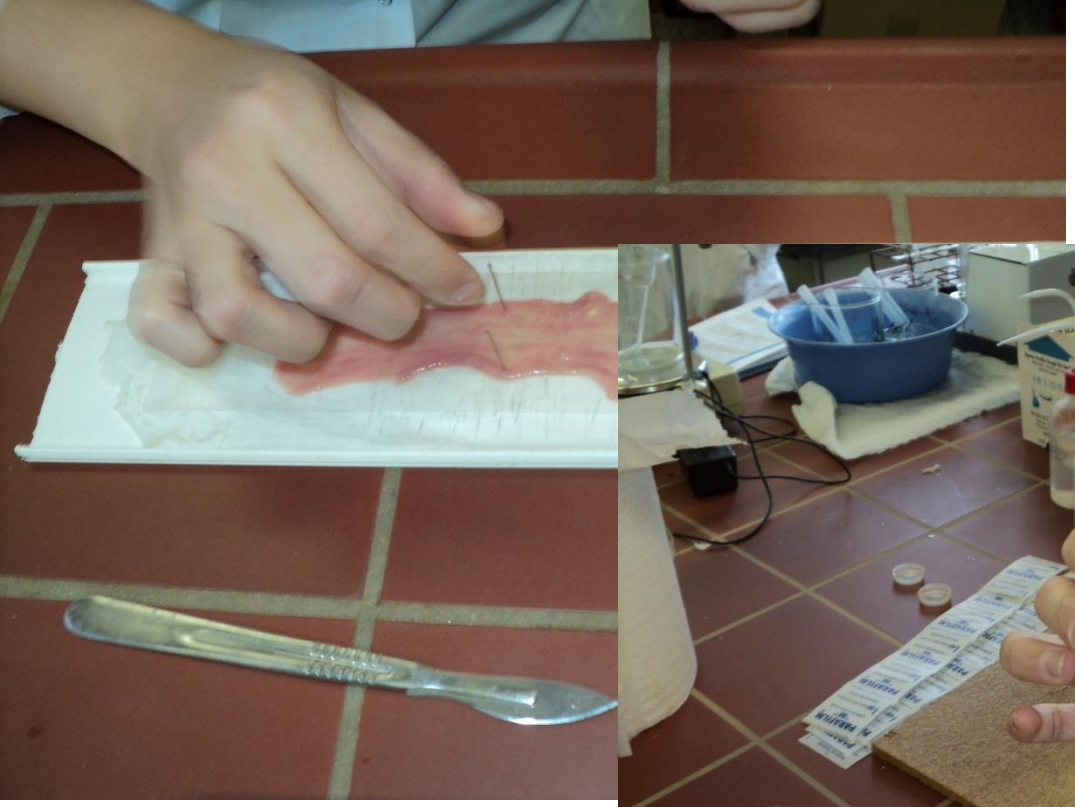
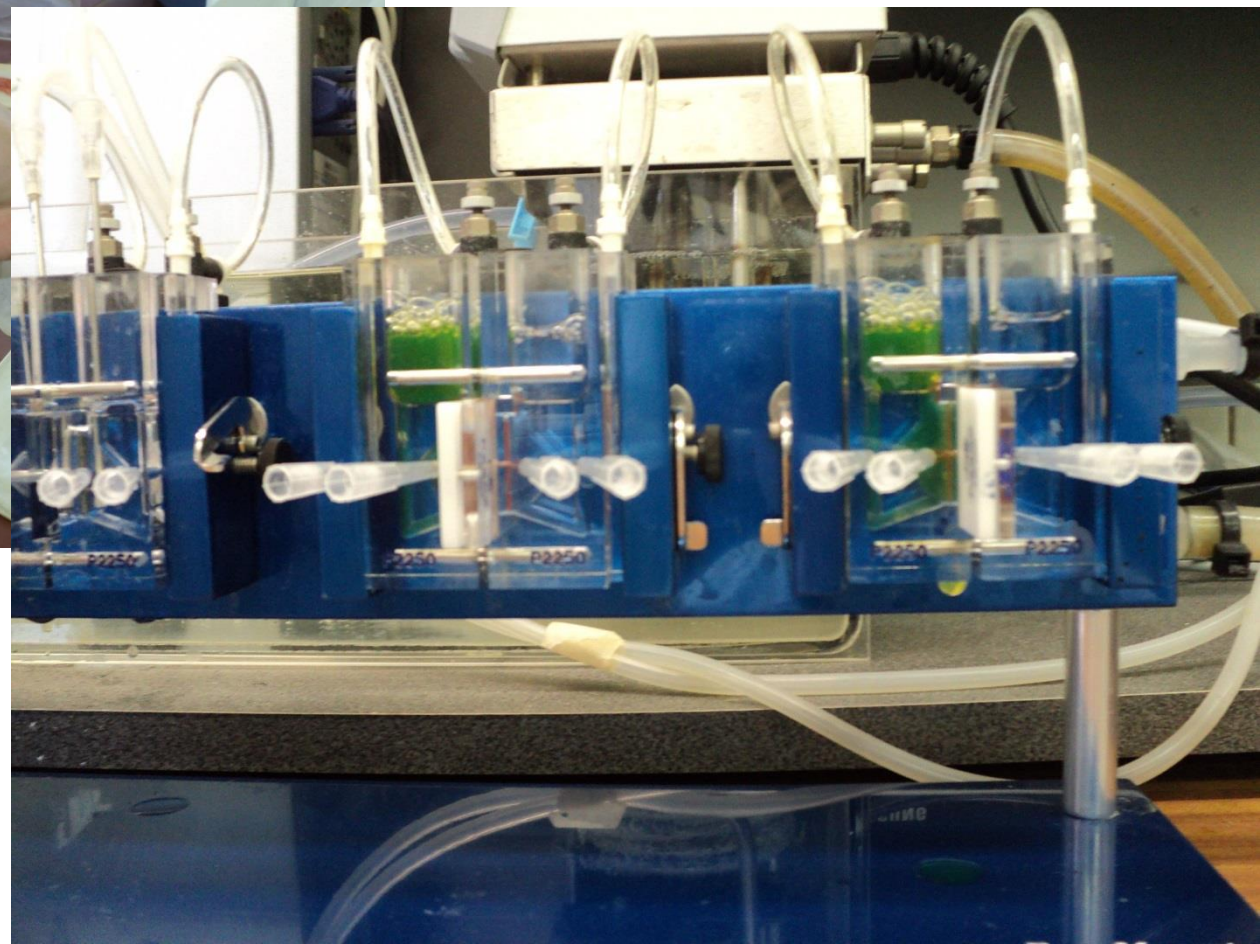


Mucosal flux for FITC dextran 4kda (**FD4**) as marker for paracellular permeability…



… and horseradish peroxidase 40kDa (**HRP**) as marker for transcellular permeability

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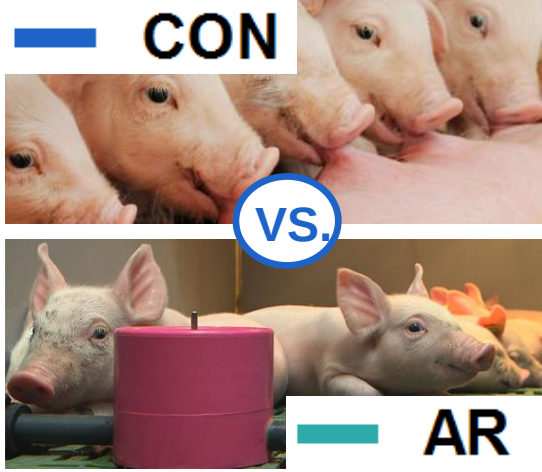
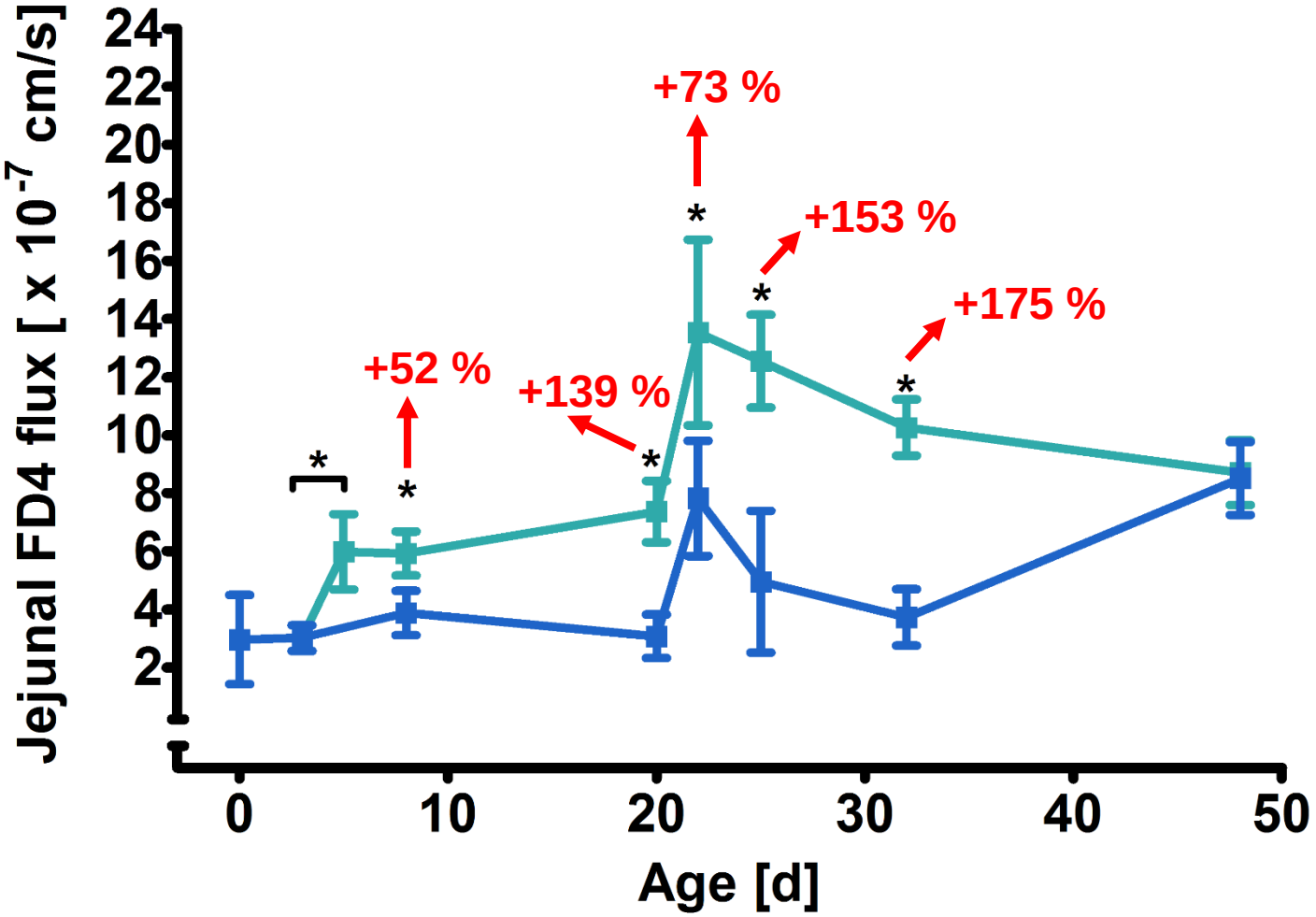
PARACELLULAR PERMEABILITY

- Higher FD4 permeability during AR (n=12; $p < 0.05$)
- Higher FD4 permeability in AR piglets during d0-14 post-weaning (n=12; $p < 0.05$)





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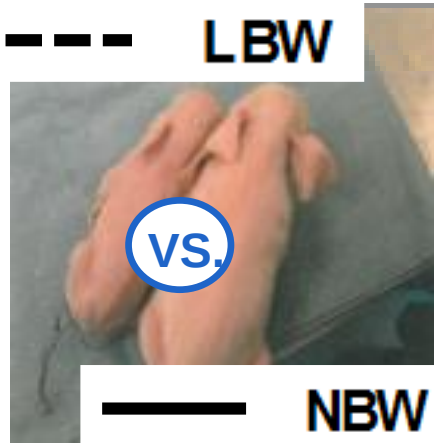
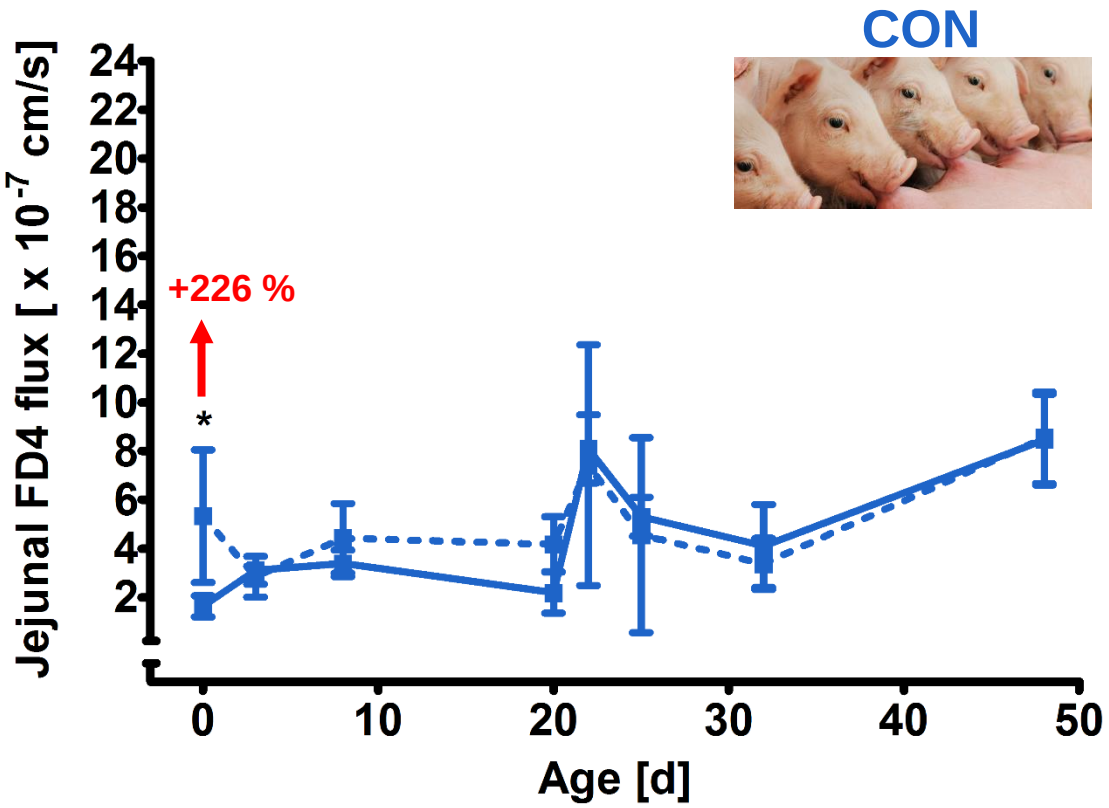
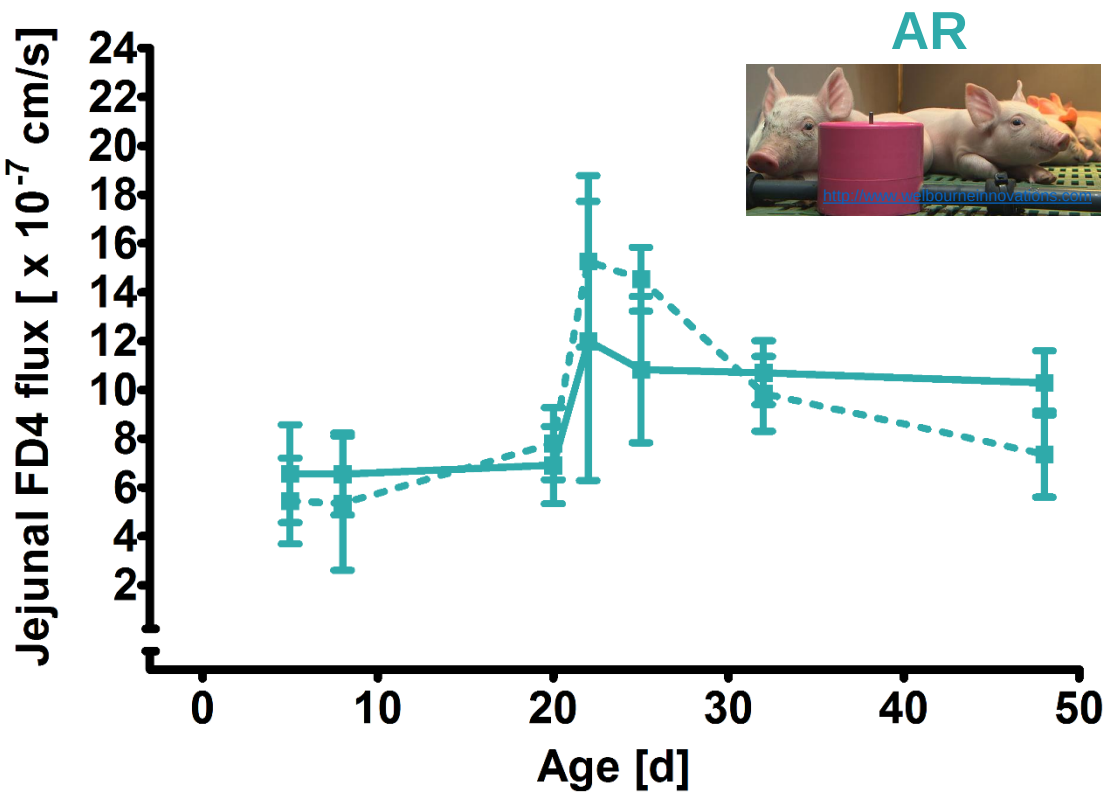
PARACELLULAR PERMEABILITY

- LBW and NBW showed an almost similar pattern (n=6; $p > 0.05$)
- Higher FD4 permeability for LBW at 0d of age (after colostrum intake) (n=6; $p < 0.05$)

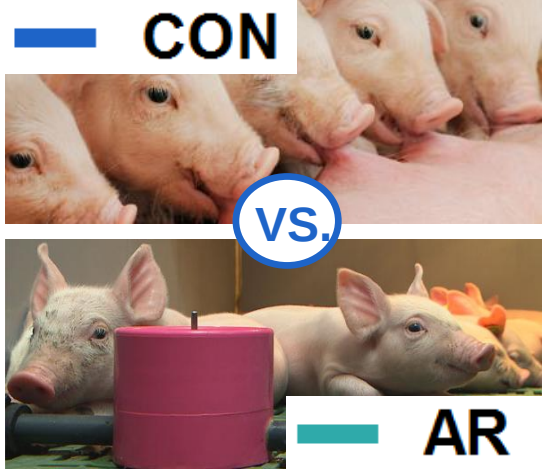


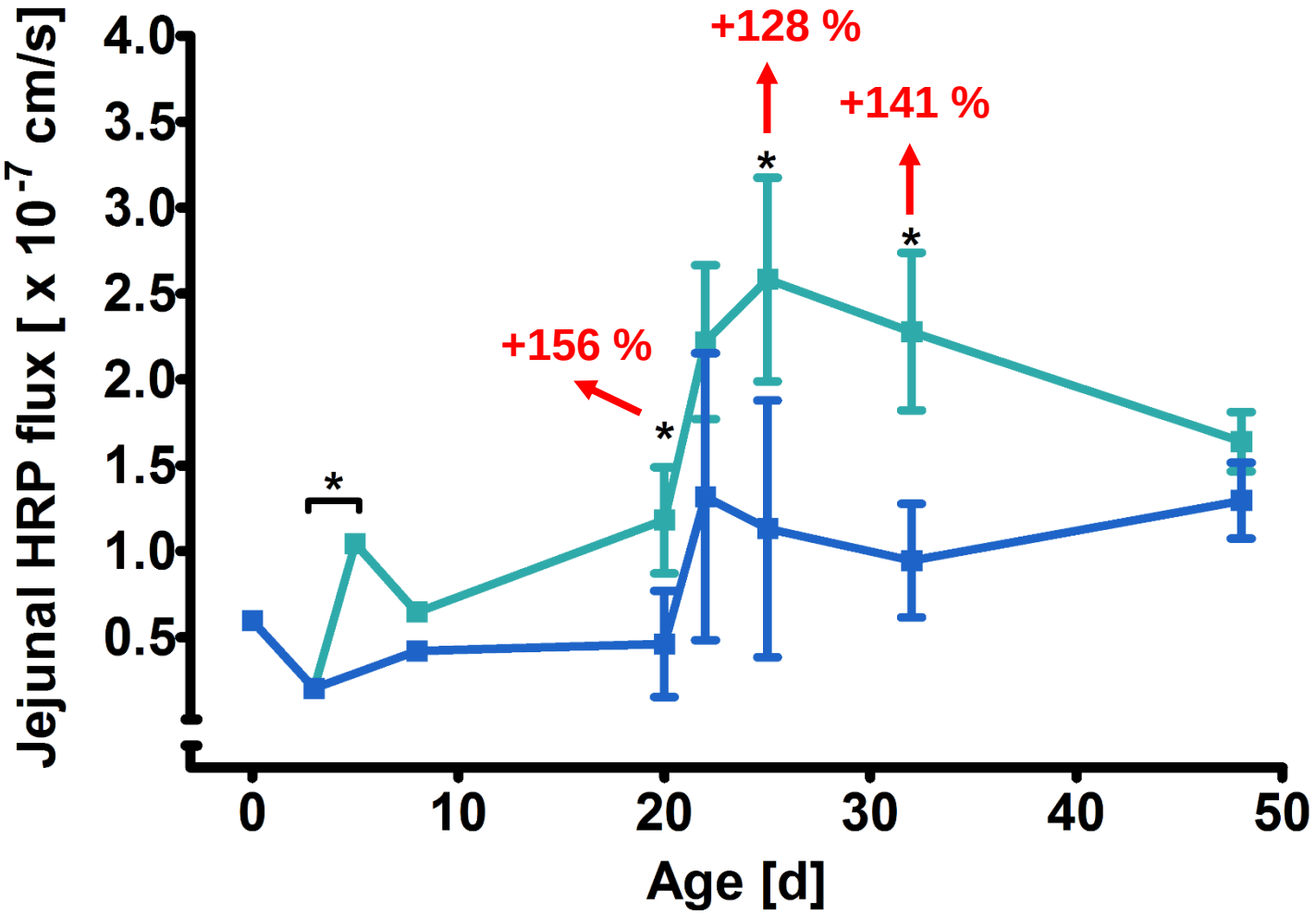




TRANSCELLULAR PERMEABILITY

- Higher HRP permeability upon maternal separation (d3 versus d5; n=12; $p < 0.05$)
- LBW and NBW showed an identical pattern (n=6; $p > 0.05$)





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CONCLUSIONS

- Artificially reared piglets (both LBW and NBW) performed better than CON piglets

- Artificial rearing impacted on the gut
  - Villus atrophy and crypt hyperplasia following maternal separation and weaning
  - Barrier disruption up till d34 of age (d14 post-weaning)

- No differences in gut parameters between LBW and NBW piglets beyond 3d of age
  - Shorter villi at 0d and 3d of age
  - Higher paracellular permeability at 0d of age

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