Effect of plant extract on growth performance, antioxidant defense system and gut health in weanling pigs infected with *Escherichia coli*

M. Comi, L. Lo Verso, X.R. Jiang, C. Domeneghini, A. Di Giancamillo, V. Dell'Orto and V. Bontempo*
Università degli Studi di Milano, Dept. Veterinary Sciences and Technologies for Food Safety,

INTRODUCTION

The objective of the present work was to evaluate the effects of a novel plant extract derived from common food plants (Grazix™ LiveLeaf Bioscience, San Carlos, CA, USA), on performance and health of weaned piglets fed mixed diet. This liquid botanical complex captures, in a stable form, the damage limiting, restorative chemistry in living plants. It consists of a synergistic combination of compounds normally segregated within intact plant cells, activated when cell damage causes these compounds to mix with catalytic enzymes. This triggers the highly efficient wound healing and pathogen resisting response found throughout the plant kingdom. Injured animal and human mucosa present enzymes with similar catalytic capability and can therefore be used to target specific challenged areas of the gastrointestinal tract. Conventional food preparation or extraction processes cause cellular disruption of plant tissues in a way that exhausts the potential of this chemistry. Consequently, these useful compounds are practically absent from most animal diets and commercial botanical medicines.

MATERIAL AND METHODS

- ❑ 144 weanling pigs (Stambo HBI Dalland 40), 24 d of age, 6.5 ± 0.35 kg LW
- ❑ 2 x 2 x 2 factorial design
- ❑ 2 dietary treatments: Control, plant extract (PE) (8µl/d/kg through drinking water from 08:00 PM to 08:00 AM) (Fig. 1)
- ❑ 2 feeding regimens: *Ad libitum*, Restricted (feed available from 8 AM to 8 PM)
- ❑ 2 levels of *E. Coli*: with, without

- ❑2 postweaning rooms (negative control, challenged)
- ❑ 6 replicates per treatment/feeding regimen/room
- ❑ 3 piglets per replicate

- ❑ All piglets from challenged room orally injected with 4 ml of a solution containing 10^9 CFU/ml of virulent *E. Coli* 0149: F4(K88)-positive strain on d 9. On day 8, 9 and 12 PE administered 200µl/d/kg of the product, and they received 400 µl/d/kg on day 10 and 11.

- ❑ One piglet per replicate withdrawn on d 0, 6, 19, 35

- ❑ 24 piglets restricted fed (Ctr and Grazix, 12 challenged, 12 negative controls) slaughtered on d 35.

RESULTS

- ❑ PE significantly decreased FCR from 7 to 14d (P<0.01), from 28 to 35 (P=0.039) and over the whole phase (P=0.012) (Fig. 2).
- ❑ Dietary PE decreased the fecal score at 7d (P=0.041), 14d (P=0.016), 21d (P<0.01) and during the last two weeks (P<0.001) (Fig. 3).
- ❑ On d 35, a lower fecal *E.Coli* concentration was determined in PE animals compared to control (P=0.017) (Fig. 4).
- ❑ Ileum crypts from PE piglets were deeper in challenged animals in comparison with not-challenged ones (P<0.05); number of mucosal macrophages was higher in Ctr challenged animals (P<0.05): in particular, number of mucosal macrophages in PE challenged piglets was similar to that one identified in not challenged controls (Tab. 1).
- ❑ In not-challenged group, PE supplementation reduced SOD in *Ad Libitum* fed piglets at d 6 (101 vs 114 U/ml, SEM 4.26, P<0.05) and increased TAOC in Restricted fed at d 35 (7.80 vs 3.21 U/ml, SEM 1.35, P<0.05).
- ❑ In challenged group PE supplementation increased GSH-Px in *Ad Libitum* fed piglets at d 6 (629 vs 516 U/ml, SEM 37, P<0.05), and decreased MDA both in *Ad Libitum* (2.76 vs 3.84 nmol/ml, SEM 0.38, P<0.05) and Restricted (2.04 vs 3.92 nmol/ml, SEM 0.38, P<0.001) fed piglets at d 6.

CONCLUSIONS

PE supplementation improved growth performance. These results were associated with fecal *E.coli* reduction in PE group. PE also resulted in a lower crypt depth in non-challenged piglets compared to challenged ones, suggesting a possible reparative action of the studied product on the small intestinal mucosa following challenge. In addition, the number of mucosal macrophages in challenged piglets from PE groups was similar to that one identified in Ctr piglets thus confirming the possible protective functional role of the plant extracts mixture after the bacterial challenge (Fig 5-8). We can postulate that the use of plant extracts may be useful in the prevention of postweaning diarrhea with an associated improvement in performance.

REFERENCES

T. Noguera, A. Dover. A pilot study of a novel common food plant extract used with oral rehydration therapy for short-term diarrhoea in adults. 2011. XIII Annual Scientific Conference, International Centre for Diarrhoeal Disease Research, Bangladesh in Dhaka, Bangladesh , March 17-20. www.icddrb.org

T. Noguera, A. Dover. A pilot study of a novel common food plant extract used with oral rehydration therapy for short-term diarrhoea in children. 2011. XIII Annual Scientific Conference, International Centre for Diarrhoeal Disease Research, Bangladesh in Dhaka, Bangladesh , March 17-20. www.icddrb.org

Fig.1: Experimental pen for PE treatment

Fig.2: Feed conversion ratio (FCR) of pigs

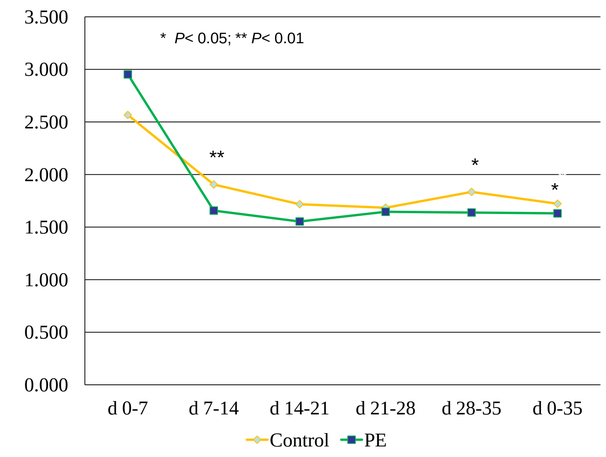

Fig.3: Fecal score of pigs 1 (hard,), 2 (firm), 3 (softt, moist stool), 4 (soft, unformed stool), 5 (watery liquid)

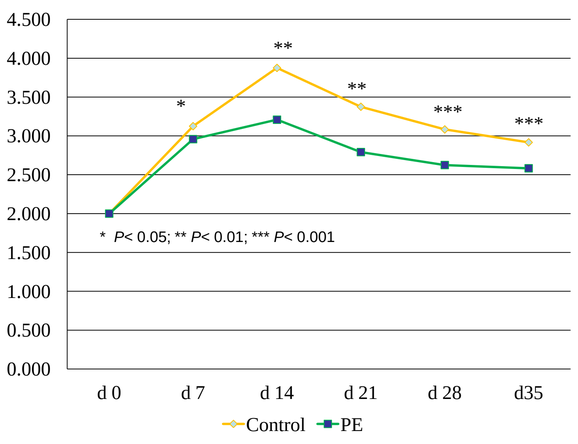

Fig.4: *E. Coli* counts (Log_{10} cfu / g) in faeces of pigs (* P< 0.05)

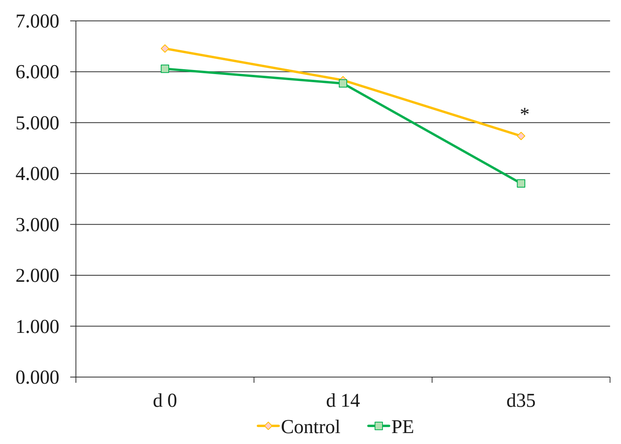

Table 1. Effect of *Grazix* supplementation on ileum hystometry, lymhatic follicles and macrophages of piglets fed restricted

Treatment	Control Restricted		PE Restricted		*P-value*
Challenge	-	+	-	+	
Villus height (V; µm)	361.34	355.12	350.82	374.53	0.474
Crypt depth (C; µm)	295.92^{ab}	285.52^{ab}	277.14^{b}	305.96^{a}	0.052
V:C	1.23	1.26	1.27	1.24	0.916
Total area, µm²	457192	441239	357818	403213	0.345
Cortex area, µm²	169184	169363	153395	173025	0.269
Medulla area, µm²	143927	41634	153759	140353	0.638
Corona area, µm²	102896	105092	109381	102799	0.900
Lymphatic Follicles, n/mm² mucosa	1.44	1.52	1.44	1.45	0.937
Macrophages, n/mm² mucosa	105.19^{b}	174.61^{a}	126.66^{b}	128.56^{b}	0.019

Values are means (n=120 for villus height, crypt depth and V:C; n=72 for Lymphatic Follicles Number; n=120 for Lymphatic Follicles Total area, Cortex area, Medulla area, Corona area; n=192 for Macrophages)

Fig.5: Control diet-not challenged, ileum, HE, 100x. All piglets showed a moderate to severe degree of catharrhal enteritis, chronic in type.

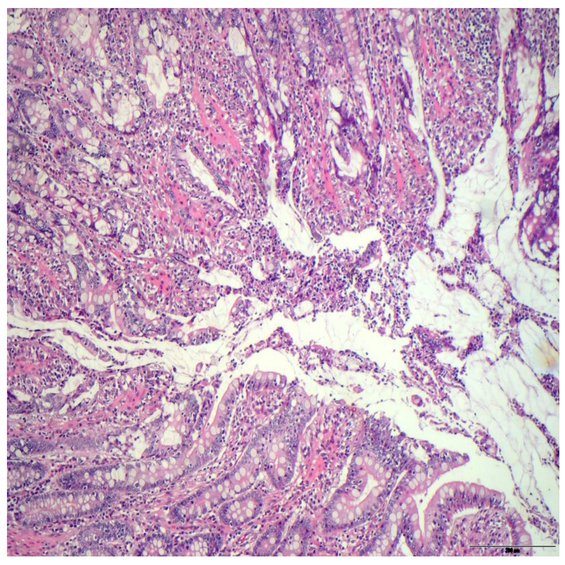

Fig.6: Control diet-challenged, ileum, HE, 100x. All piglets showed a moderate to severe degree of catharrhal enteritis chronic in type.

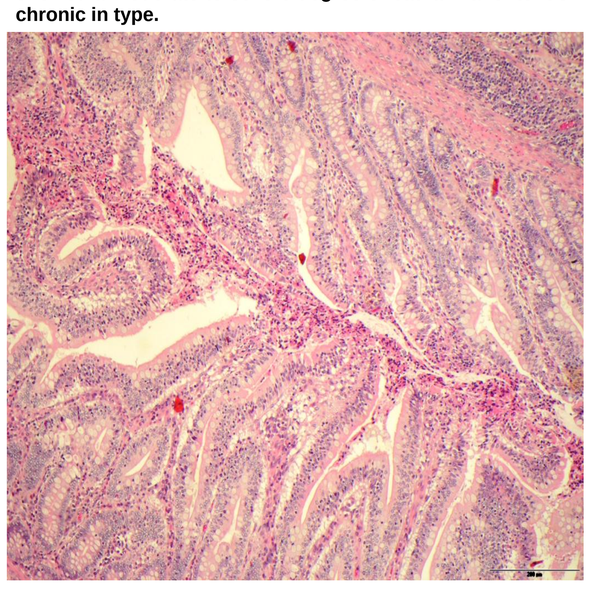

Fig.7: PE diet-not challenged, ileum, HE, 100x. All piglets showed a moderate to severe degree of catharrhal enteritis, chronic in type

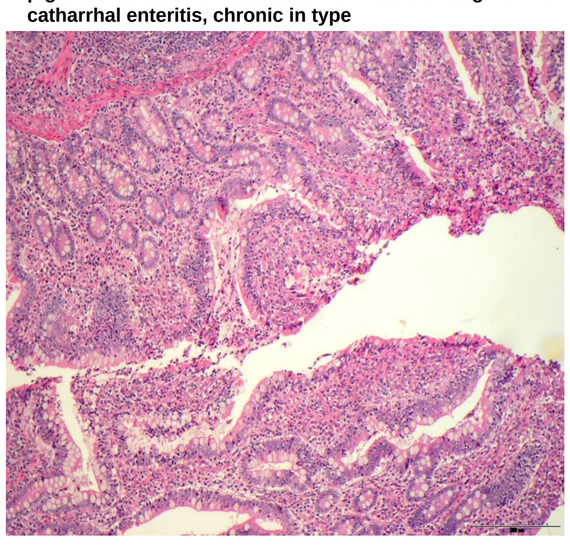

Fig.8: PE diet-challenged, ileum, HE, 100x. All piglets showed a slight to moderate catharrhal enteritis, chronic in type