Strategies of use of an specific immunoglobulin-rich egg yolk powder in weaning piglets

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Abstract

Two experiments were performed to determine the best strategy of use of the product TRACTcare® 4P (specific immunoglobulin-rich egg yolk powder within an energetic fatty acid matrix) in piglets from weaning and for 6 weeks, in diets without or with inclusion of antibiotics. Each trial was performed with 144 piglets in 24 pens, in a completely randomized design blocked by initial body weight. Feeds were formulated according to animal requirements in two periods. In the first trial no antibiotics were included in the feeds and no room disinfection from previous trial was performed; treatments were: 1) Negative control (NC); 2) NC + TRACTcare® on top of the feed within the hopper for the first 3 days on trial (30 g/pig x day), and eventually if diarrhea appeared (TCOT); 3) NC + TRACTcare® *ad libitum* provided in an extra hopper within the pen (TCAL); and 4) NC + TRACTcare® at 5 g/kg added to the feed in the mixer (TC5). In the second trial, treatments were: 1) Positive control: basal diet that included 250 mg/kg amoxiciline (BD) + 100 mg/kg colistine (AC); 2) BD + 2 g/kg TRACTcare® (TC2A); 3) BD + 5 g/kg TRACTcare® (TC5A); and 4) BD + 8 g/kg TRACTcare® (TC8A). In diets without antibiotics, the product TRACTcare® 4P at 5 g/kg in the feed numerically improved BW by 8% compared to Control animals, while G:F was almost identical between both groups. When antibiotics were used in the feed, replacement of

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colistin at 100 mg/kg for TRACTcare® 4P at 2 g/kg in feed numerically improved the performance compared to Positive Control animals (for the whole trial period ADG 8% better: 390 g *vs.* 361 g; G:F 1% better: 0.748 kg/kg *vs.* 0.742 kg/kg), possibly due to the stimulation of feed consumption at weaning. In both trials, the lower number of dead and culled animals from TC5 and TC2A together with higher BW represented an advantage over Control treatments of 6% to 10% animals more and 15% to 17% total BW more at the end of the trial.

Keywords: piglets; weaning; diarrhea; egg yolk immunoglobulin.

Introduction

Enterotoxigenic *Escherichia coli* (ETEC) diarrhea is the most common enteric disease in piglets, representing 50% of the 10 million piglets that die annually worldwide (Gyles, 1994). Fimbrial adhesins F4 and F18 are the most common in strains of *E. coli* associated with intestinal colonization in piglets (Nagy and Fekete, 1999). Passive protection against ETEC can be achieved by specific antibodies from egg yolks of immunized hens (Yokoyama*, et al.*, 1992), that act locally in the gut, resulting in growth promoting effects in piglets (Owusu-Asiedu*, et al.*, 2002). Medium Chain Fatty Acids (MCFA) are a source of readily available energy very efficient to compensate negative energy balances in young and vulnerable animals (Odle, 1997) and may also have growth promoting effects (Decuypere and Dierick, 2003). The aims of these studies were to assess the effect of specific immunoglobulin-rich egg yolk powder within an energetic fatty acid matrix (TRACTcare® 4P) in weaning piglets, and to determine the best strategy of use of this product.

Material and methods

Animals and housing

The experiments followed the EU principals for animal care and experimentation. Each trial was performed with 144 entire male piglets allocated in 24 slated floor pens.

Experimental design

The experiments were set as completely randomized design. Feeds were formulated according to animal requirements (NRC, 1998) in two periods. In the first trial no antibiotics were included in the feeds and no room disinfection from previous trial was performed; treatments were: 1) Negative control (NC); 2) NC + TRACTcare® on top of the feed within the hopper for the first 3 days on trial (30 g/pig x day), and eventually if diarrhea appeared (TCOT); 3) NC + TRACTcare® *ad libitum* provided in an extra hopper within the pen (TCAL); and 4) NC + TRACTcare® at 5 g/kg in the feed (TC5). In the second trial, treatments were: 1) Positive control: basal diet that included 250 mg/kg amoxiciline (BD) + 100 mg/kg colistine (AC); 2) BD + 2 g/kg TRACTcare® (TC2A); 3) BD + 5 g/kg TRACTcare® (TC5A); and 4) BD + 8 g/kg TRACTcare® (TC8A).

Body Weight (BW) and pen feed intake were controlled at the beginning, at day 14 and at the end of the experiments (44 and 40 days). The appearance of diarrhea was controlled and administration of therapeutic treatments recorded (diarrhea was treated with 3 oral administrations at 12 h interval of 2 g of Fast Pro 18® in 10 mL water -egg powder rich in IgY against *E. coli* F18; Zyme Fast Inc., Canada-). Rectal swabs were performed to confirm the microorganism causative of diarrhea (F18 FastTEST®; Zyme Fast Inc., Canada). Gain to Feed ratio (G:F), Average Daily Gain (ADG), and Average Daily Feed Intake (ADFI) were calculated thereafter. Consumption of TRACTcare® 4P in TCOT animals was checked at 1, 2, 5, 14 and 44 days.

Statistical Analysis

Data was analyzed according the design of the experiments; one pen was considered the experimental unit. Analysis was performed using the appropriate procedures of SAS System for Windows V9.1.3 (SAS, 2003): GLM for performance variables, and NPAR1WAY for number of dead animals. Significance was considered at $P \leq 0.05$.

Results

Results are presented in Table 1 and Table 2 for the first and second experiments respectively. Diarrhea was more severe and affected more animals in the first than in the second trial. Few TC5 animals were culled or died than NC animals (4 *vs.* 7) but the difference did not reach significance (P=0.153 Wilcoxon test). Rectal swabs at 15 days confirmed *E. coli* F18 as the causing agent and not F4 to which TRACTcare® 4P is mainly directed. Diarrhea ceased after oral administration of Fast Pro 18® (number of animals treated were: TCOT: 8; TCAL: 10; TC5: 6). The incidence of diarrhea impaired performance and increased variability, especially in the first trial. ADG during the Starter period was numerically improved in TC5 animals compared to NC animals (522 g *vs.* 462 g); G:F was not significantly different between these treatments (0.723 *vs.* 0.718), therefore the improvement in ADG could be a consequence of a better health status which stimulated feed consumption (numerically higher ADFI: 724 g *vs.* 645 g). Trends for the whole trial period were similar to the Starter period. Animals from TC5 were numerically heavier at the end of the trial than NC animals (22.1 kg *vs.* 20.4 kg), with numerically higher ADFI (539 g *vs.* 483 g) while G:F was identical for both treatments. This fact together with a lower number of dead and culled animals from TC5, represented an advantage over NC treatment of 10% animals more and 17% kg of total BW more at the end of the trial. When TRACTcare® 4P was

offered for *ad libitum* consumption, animals consumed 13.2 fold and 1.7 fold the amount of product that animals from TC5, for the pre-starter and starter phase. However, ADG was not improved. These results indicate either that TRACTcare® 4P was not effective or more likely that the product was not really consumed by animals and the disappearance reflected spilling of the product.

In the pre-starter period of the second experiment TC2A had numerically higher values than AC (ADG 159 g *vs.* 115 g; G:F 0.861 *vs.* 0.738). Also, TC2A had numerically higher BW, ADG, ADFI and G:F than TC5A and TC8A. TC2A and TC8A animals gained more weight and weighted more than AC and TC5A animals at the end of the trial (BW 21.90 kg and 22.12 kg *vs.* 20.86 kg and 19.43 kg; ADG 514 g and 536 g *vs.* 493 g and 445 g).

Discussion

Animals with TRACTcare® 4P in the feed were numerically heavier than NC animals at the end of the trial, and fewer animals died or were culled due to diarrhea. These results confirmed the protective effect of egg yolk immunoglobulins against ETEC demonstrated by Yokoyama*, et al.* (1992) and Owusu-Asiedu*, et al.* (2003). MCFA also are a source of readily available energy very efficient to compensate negative energy balances in young and vulnerable animals (Odle, 1997). Animals offered the product on top of the feed or *ad libitum* most likely did not eat it at all due to the repellent odor and taste of MCFA (Decuypere and Dierick, 2003) and could not benefit from the effects of egg yolk immunoglobulins and MCFA. Replacement of colistin by TRACTcare® 4P did not impair performance results of the animals at the end of the experimental period, but for G:F in TC5A animals. Results for TC5A are not in accordance with TC2A and TC8A. Animals from this treatment might be subclinically

affected by *E. coli* F18 as animals from the first experiment, but diarrhea was not detected nor treated.

Conclusions

The best strategy to use the product TRACTcare® 4P in weaning piglets was to include the product in the feed. Although differences did not reach significance, TC5 animals were 8% heavier than NC animals at the end of the trial and ate 12% more while G:F was identical between both groups. This fact together with a lower number of dead and culled animals from TC5 represented an advantage over Control treatment of 10% animals more and 17% kg of total BW more at the end of the trial.

Replacement of colistin for TRACTcare® 4P in the feed did not significantly impair weight gain or feed intake. On the contrary, TC2A animals performed numerically better than AC animals for the whole trial period (ADG 8% better; G:F 1% better), probably due to the stimulation of feed consumption at weaning. Moreover, only one animal was culled from TC2A, while three animals had to be culled from AC due to poor performance or considerable weight loss.

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Table 1.
Summary results of performance variables (n=6 replicates (pen) per treatment) for the whole trial period (1 to 44 days) from Experiment 1[1]

		BW[2] (kg)	ADG[2] (g)	ADFI[2] (kg/kg)	G:F[2]	culled and dead (%)
Pre-starter phase						
NC		6.49 ±0.493	61 ±8.8	136 ±6.3	0.438 ±0.0467	2.8 ±2.78
TCOT		6.34 ±0.675	51 ±26.9	143 ±21.1	0.243 ±0.2331	5.6 ±3.51
TCAL		6.07 ±0.354	32 ±11.8	167 ±16.6	0.208 ±0.0778	5.6 ±5.56
TC5		6.40 ±0.579	56 ±14.2	141 ±11.1	0.377 ±0.0705	0.0 ±0.00
	P value	0.650	0.650	0.443	0.558	0.420
Starter phase						
NC		20.39 ±1.177	462 ±25.4	645 ±37.8 ^{B}	0.718 ±0.0189 ^{a}	16.7 ±6.09
TCOT		20.96 ±1.563	473 ±36.4	750 ±24.7 ^{A}	0.628 ±0.0363 ^{b}	30.6 ±11.72
TCAL		20.72 ±1.072	481 ±21.8	701 ±34.4 ^{AB}	0.687 ±0.0060 ^{ab}	16.7 ±6.09
TC5		22.08 ±1.475	522 ±33.1	724 ±48.8 ^{AB}	0.723 ±0.0041 ^{a}	11.1 ±3.52
	P value	0.324	0.127	0.073	*	0.429
Whole trial						
NC		20.39 ±1.177	334 ±18.7	483 ±26.6 ^{B}	0.693 ±0.0155 ^{a}	19.4 ±6.69
TCOT		20.96 ±1.563	339 ±32.5	557 ±20.7 ^{A}	0.605 ±0.0454 ^{b}	36.1 ±13.89
TCAL		20.72 ±1.072	338 ±14.5	531 ±21.6 ^{AB}	0.637 ±0.0125 ^{ab}	22.2 ±8.24
TC5		22.08 ±1.475	374 ±26.6	539 ±35.7 ^{AB}	0.693 ±0.0048 ^{a}	11.1 ±3.51
	P value	0.324	0.306	0.093	*	0.327

[1] No antibiotics were included in the feeds. Treatments were: 1) Negative control (NC); 2) NC + TRACTcare® on top of the feed within the hopper for the first 3 days on trial (30 g/pig x day), and eventually if diarrhea appeared (TCOT); 3) NC + TRACTcare® *ad libitum* provided in an extra hopper within the pen (TCAL); and 4) NC + TRACTcare® at 5 g/kg added to the feed in the mixer (TC5).

[2] BW = Body weight; ADG = Average Daily Gain; ADFI = Average Daily Feed Intake; G:F = Gain to Feed ratio

^{ab} values in the same row with uncommon superscripts differ ($P \leq 0.05$)

^{AB} values in the same row with uncommon superscripts differ ($P \leq 0.10$)

Table 2.
Summary results of performance variables (n=6 replicates (pen) per treatment) for the whole trial period (1 to 40 days) from Experiment 2[1]

		BW[2] (kg)	ADG[2] (g)	ADFI[2] (kg/kg)	G:F[2]	culled and dead (%)
Pre-starter phase						
AC		7.83 ±0.317	115 ±8.9	154 ±6.0	0.738 ±0.0329	0
TC2A		8.46 ±0.292	159 ±18.2	182 ±13.7	0.861 ±0.0439	0
TC5A		7.71 ±0.439	104 ±19.0	146 ±15.2	0.683 ±0.0681	0
TC8A		7.69 ±0.256	106 ±30.7	146 ±20.7	0.631 ±0.1425	0
	P value	0.184	0.161	0.262	0.197	-
Starter phase						
AC		20.86 ±0.939	493 ±27.1	667 ±41.1	0.741 ±0.0083	8.3 ±5.69
TC2A		21.90 ±0.608	514 ±17.2	704 ±25.2	0.731 ±0.0086	2.8 ±2.78
TC5A		19.43 ±1.126	445 ±29.6	619 ±44.0	0.721 ±0.0091	8.3 ±3.73
TC8A		22.12 ±0.587	536 ±18.4	736 ±31.1	0.729 ±0.0085	16.7 ±6.09
	P value	0.172	0.133	0.216	0.393	0.230
Whole trial						
AC		20.86 ±0.939	361 ±16.9	487 ±26.8	0.742 ±0.0089 [ab]	8.3 ±5.69
TC2A		21.90 ±0.608	390 ±16.5	521 ±20.2	0.748 ±0.0091 [a]	2.8 ±2.78
TC5A		19.43 ±1.126	326 ±23.9	453 ±32.9	0.718 ±0.0076 [c]	8.3 ±3.73
TC8A		22.12 ±0.587	385 ±19.8	530 ±24.7	0.726 ±0.0082 [bc]	16.7 ±6.09
	P value	0.172	0.177	0.271	**	0.230

[1] Treatments were: 1) Positive control: basal diet that included 250 mg/kg amoxiciline (BD) + 100 mg/kg colistine (AC); 2) BD + 2 g/kg TRACTcare® (TC2A); 3) BD + 5 g/kg TRACTcare® (TC5A); and 4) BD + 8 g/kg TRACTcare® (TC8A).
[2] BW = Body weight; ADG = Average Daily Gain; ADFI = Average Daily Feed Intake; G:F = Gain to Feed ratio
[ab] values in the same row with uncommon superscripts differ ($P \leq 0.05$)
[AB] values in the same row with uncommon superscripts differ ($P \leq 0.10$)