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Faecal pH and growth performance in weaned piglets fed diets with an organic acid blend

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Abstract: *The use of organic acids in pig nutrition is considered a potential alternative to antibiotic growth promoters, but their effects on gut environment and performance in weaned piglets remain inconsistent. This study evaluated the impact of a commercial organic acid blend added to the diet on faecal pH and basic growth performance parameters in weaned piglets. Eight piglets were randomly allocated to two groups: a control group fed a basal diet and an experimental group fed the same diet supplemented with an organic acid blend. The trial lasted three weeks. Body weight was recorded weekly and used to calculate average daily gain (ADG). Feed intake was measured and feed conversion ratio (FCR) was calculated for each group. Faecal samples were collected once a week and their pH was measured. Inclusion of the acidifier reduced the pH of the feed from 5.13 to 4.82, but no statistically significant differences (P > 0.05) in body weight, ADG, feed intake or FCR were observed between the two groups. Faecal pH decreased over time in both groups, with only minor, non-significant differences between treatments. These results indicate that, under the conditions of this study, the applied organic acid blend did not markedly improve growth performance, and faecal pH had limited value as a sole non-invasive indicator of dietary acidification in weaned piglets.*

I. INTRODUCTION

The withdrawal and progressive restriction of antibiotic growth promoters in many countries has intensified the search for alternative nutritional strategies to maintain intestinal health and performance in pigs. Among the proposed options, organic acids and their salts are widely used because they can lower gastric pH, enhance nutrient digestibility, influence the composition of gut microbiota and help reduce post-weaning diarrhoea in piglets [1, 2].

In weaned pigs, acidifiers are intended to support the still-developing gastric acid secretion. By promoting a lower pH in the stomach, they are expected to improve protein digestion and suppress the growth of pathogenic bacteria [3, 4]. Numerous experiments have reported positive effects of dietary organic acids on growth rate, feed efficiency and health status, particularly during the early post-weaning phase [5, 6, 7]. On the other hand, several studies have demonstrated only modest or no improvements in average daily gain (ADG), average daily feed intake (ADFI) or feed conversion ratio, especially in older piglets that are already adapted to solid feed [8, 9, 10]. The variability in response appears to be influenced by the type and inclusion level of the acids used, diet composition, age and physiological status of the animals, as well as overall management [11]. Besides their beneficial effects on gastric pH and nutrient digestibility, dietary acidifiers have also been discussed in the context of gastric ulcer pathogenesis, although current data on whether they aggravate or do not affect gastric lesions are limited and partly inconsistent [12, 13, 14, 15].

Assessing the efficacy of dietary acidifiers is further complicated by the difficulty of measuring their effect on the gastrointestinal environment, particularly gastric pH. Direct sampling of stomach contents usually requires euthanasia of animals and strict standardisation of the time relative to feeding, making this approach invasive, labour-intensive and less suitable for smaller trials [16]. For this reason, several authors have explored faecal pH as a simple, non-invasive and inexpensive parameter that may reflect changes in the hindgut environment and, indirectly, the impact of dietary acidification [17, 18, 19]. However, the relationship between dietary acidifiers, gastric pH and faecal pH is not fully clarified, and the suitability of faecal pH as an indicator of acidifier efficacy remains under discussion [20].

In this context, the present study was designed to evaluate the effect of adding a commercial organic acid blend to the diet of weaned piglets on faecal pH and basic growth performance traits. It was hypothesised that dietary acidification would reduce the pH of the feed, modify faecal pH and improve performance (ADG, feed intake and feed conversion ratio) compared with a non-acidified control diet.

II. MATERIALS AND METHODS

Animals and housing

The experiment was conducted on eight clinically healthy weaned piglets of similar genetic background, originating from the same litter. At the beginning of the trial, the piglets were 36 days old and had already undergone a period of adaptation to solid feed. Animals were housed in identical hygienic and social conditions, in two pens with comparable space allowance, bedding and environmental parameters (temperature, ventilation and lighting). Water was available *ad libitum* via nipple drinkers.

Experimental design and diets

Piglets were randomly allocated into two groups (n = 4 per group):

Control group (CON): basal diet without acidifier.

Experimental group (ACID): basal diet supplemented with a commercial organic acid blend (Schaumacid Protect, Schaumann) at an inclusion level of 12.5 g/kg feed, in accordance with the manufacturer's recommendation. The acidifier consisted of a mixture of organic acids and their salts (including, for example, lactic, propionic, citric and formic acids, as well as sorbic acid) and was coated to allow gradual release within the gastrointestinal tract, as typically used in practice [20, 6]. The exact composition and inclusion level followed the producer's specifications.

After addition of the acidifier, the pH of the feed was measured using a calibrated pH meter. The pH of the control diet was 5.13, whereas the pH of the acidified diet was 4.82, in line with previous observations that organic acid blends effectively reduce feed pH [21].

The duration of the experiment was three weeks. Piglets were fed the respective diets throughout the whole trial, with feed provision adjusted to ensure *ad libitum* intake.

Growth performance

Each piglet was individually weighed at the beginning of the experiment (day 0) and then once a week (week 1, week 2 and week 3). Body weight (BW) values were used to calculate average daily gain (ADG) for each pig and each experimental period, similarly to other studies evaluating acidifiers in weaned pigs [9, 10].

Feed consumption was recorded per group. The amount of feed offered and refused was weighed, and weekly feed intake per pig was calculated. Feed conversion ratio (FCR) for each group was calculated as the ratio of total feed intake to total body weight gain over the observed period.

Faecal pH

Faecal samples were collected once a week from each piglet. Fresh faeces were collected directly from the rectum using clean gloves.

Faecal pH was measured immediately after collection. A defined amount of faeces was homogenised with a small volume of distilled water to obtain a semi-liquid suspension, and pH was measured using a portable, calibrated pH meter with a glass electrode suitable for semi-solid materials, as described in similar studies [17, 18]. Faecal pH was recorded for each piglet and then averaged per group and sampling week.

Statistical analysis

Data on feed intake, body weight, ADG, FCR and faecal pH were processed using standard descriptive statistics (mean and standard deviation). Differences between the control and experimental groups were assessed using the Student's t-test for independent samples. A value of $P \leq 0.05$ was considered statistically significant. Statistical analyses were performed using Microsoft Excel.

III. RESULTS AND DISCUSSION

Inclusion of the organic acid blend reduced the pH of the feed (5.13 vs. 4.82 in the control and experimental diets), confirming its acidifying effect on the ration [20]. Despite this, no statistically significant differences ($P > 0.05$) in body weight or average daily gain (ADG) were observed between groups during the three-week trial. Both groups showed a similar, gradual increase in body weight, which agrees with studies where acidifiers did not markedly improve growth in older or already adapted piglets [8, 9].

Total feed intake increased over time in both treatments (Table 1). In the third week, the control group consumed 26.4 kg of feed and the experimental group 28.6 kg, corresponding to 774 g and 805 g per pig per day, respectively. Thus, the organic acid blend did not depress voluntary feed intake; a slight numerical increase was observed, contrary to some reports of reduced palatability with acidifiers [7].

However, this higher intake did not improve feed efficiency. Overall feed conversion ratio (FCR) for the whole period was 1.633 in the control group and 1.642 in the experimental group. A similar lack of clear effects on FCR has been reported in other works with dietary organic acids [8, 9, 10]. The age of the piglets (36 days) and previous adaptation to solid feed likely reduced the potential response to acidification, as organic acids are considered most beneficial shortly after weaning when gastric acid secretion is still immature [2, 5].

Table 1. Body weight, average daily gain, feed intake and feed conversion ratio of weaned piglets fed control or acidified diet

Parameter	Group	Week 0	Week 1	Week 2	Week 3	Whole experiment
Body weight (kg)	Control	11.12	14.18	16.40	21.07	-
	Experimental	10.95	14.07	16.15	21.25	-
ADG (kg/day)	Control	-	0.436	0.317	0.669	0.474
	Experimental	-	0.447	0.296	0.728	0.490
Feed intake (kg/pig/day)	Control	-	0.510	0.860	0.940	0.774
	Experimental	-	0.510	0.880	1.020	0.805
FCR (kg feed/kg gain)	Control	-	-	-	-	1.633
	Experimental	-	-	-	-	1.642

Mean faecal pH values over the three weeks are presented in Table 2. At the beginning of the experiment, faecal pH was similar in both groups. A gradual decrease was recorded over time in both treatments: from 6.85 to 6.33 in the control group and from 6.64 to 5.72 in the experimental group (weeks 1 to 3). Although the acidifier group tended to show slightly lower pH at the end of the trial, differences between groups at individual sampling times were small and not statistically significant (P = 0.42; 0.37 and 0.57 for weeks 1, 2 and 3).

The overall pattern reflects normal post-weaning changes in the gastrointestinal environment. Reported values for faecal or distal colon pH in piglets and sows are within a similar range [17, 18, 19]. The lack of a clear treatment effect suggests that faecal pH is not a sensitive marker of dietary acidification under these conditions. This is consistent with the physiological understanding that organic acids act mainly in the stomach and proximal small intestine [1, 3], while their activity in the hindgut is limited once the acids are dissociated and partly absorbed [20]. Since faecal pH primarily reflects conditions in the large intestine and microbial fermentation, it may correlate only weakly with gastric acidification.

Table 2. Faecal pH (mean ± SD) in control and experimental groups of weaned piglets

Group of animals	Week 1	Week 2	Week 3
Control	6.85 ± 0.33	7.04 ± 0.40	6.33 ± 0.09
Experimental	6.64 ± 0.37	6.87 ± 0.07	5.72 ± 0.26
P-value	0.42	0.37	0.57

The small number of animals (n = 4 per each group) further reduced the statistical power to detect subtle differences [5]. Nevertheless, the present data support the view that the response to dietary organic acids in weaned piglets is highly context-dependent and that faecal pH, although simple and non-invasive, should not be used as a sole indicator of dietary acidification or gut health. Future studies with larger groups, different acidifier formulations and routes of administration (e.g. via drinking water) and, where possible, more direct assessment of gastric pH [6, 16, 22] are warranted.

IV. CONCLUSION

This study showed that adding a commercial organic acid blend to the diet of weaned piglets reduced feed pH, but did not lead to significant improvements in body weight, average daily gain, feed intake or feed conversion ratio during the three-week experimental period.

Faecal pH decreased over time in both the control and acidified groups, reflecting post-weaning changes in the gastrointestinal environment; however, the differences between treatments were small and not statistically significant.

Overall, the results indicate that faecal pH has limited value as a sole non-invasive indicator of dietary acidification in weaned piglets, probably because the main effects of organic acids occur in the proximal parts of the gastrointestinal tract rather than in the hindgut. Further research with a larger number of animals, different acidifier formulations and routes of administration, as well as more direct methods of assessing gastric pH, is needed to clarify the relationship between dietary acidifiers, gut environment and performance in weaned pigs.

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