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Organic Acids Effective to Ameliorate the Negative Impact on Broiler Performance Due to Necrotic Enteritis

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INTRODUCTION

Consumer pressure and legislative action preventing the use of non-therapeutic antibiotics has broiler producers worldwide searching for natural alternatives to control necrotic enteritis (N.E.), a disease that costs them about $0.05 per bird, and the global poultry industry an estimated $2 billion each year. Organic acids represent a dietary intervention that can act against *C. perfringens* and other pathogens such as *Salmonella, Campylobacter* and *Listeria*. The acidic intestinal environment they create suppresses pathogenic bacteria while promoting beneficial bacterial growth. The degree of antimicrobial effect varies from one acid to another and is dependent on concentration and pH. Both individual acids and blends of several acids have been used in swine diets for decades and appear to provide many of the benefits of antibiotics.

MATERIALS AND METHODS

A research trial was done to study the effects of organic acids on *C. perfringens* colonization and intestinal microbial populations using a N.E. model previously described (1). Briefly, 630 day-old chicks were placed in cages and divided into five treatment groups with nine replicates each (Table 1). The first group was the negative control and received no medication and was not challenged with pathogens. The second group received no medication, but was challenged on day 14 with *Coccidia*, (*Eimeria acervulina* at 25,000 viable sporulated oocyst/bird and *Eimeria maxima* at 15,000 viable sporulated oocyst/bird), and on days 18, 19 and 20 with 10^8 CFU/bird of *C. perfringens*. The third group was given bacitracin methylene disalicylate (BMD) at 50g/ton and was challenged with *Coccidia and C. perfringens* on the same days and at the same levels as the second group. Groups four and five were given an organic acid blend via their drinking water at a 0.04% concentration. Group four received ACTIVATE® EU nutritional feed acid, an acid blend specifically developed for the EU, while the group five birds were given ACTIVATE® US, a blend formulated for the U.S. The group four and five birds were challenged with the same pathogens on the same days and at the same levels as the second and third group (see Table 1). Parameters tested included adjusted feed conversion, feed and water intake, weight gain, mortality and necrotic enteritis lesion score as previously described (1).

Table 1. Experimental Design

Treatment		Coccidial Challenge (25K E. a, 15K E.m)	*C. Perfringens* Challenge (10^8 CFU/bird)
1	No medication No challenge	NO	NO
2	No medication Challenge	Day 14	Days 18, 19, 20
3	BMD 50 g/t	Day 14	Days 18, 19, 20
4	ACTIVATE EU 0.04%	Day 14	Days 18, 19, 20
5	ACTIVATE US 0.04%	Day 14	Days 18, 19, 20

BMD: bacitracin methylene disalicylate
ACTIVATE EU: Formic acid, Phosphoric Acid, 2-hydroxy-4-Methylthio Butanoic acid (HMTBa)
ACTIVATE US: Lactic acid, Phosphoric Acid, 2-hydroxy-4-Methylthio Butanoic acid (HMTBa)

RESULTS AND DISCUSSION

During the course of the trial, adjusted feed conversion, weight gain, lesion scores and mortality data were collected. The three groups receiving treatments three, four and five showed marked feed conversion improvement when compared to group 2, the non-medicated, challenged birds. Additionally, supplementing the drinking water with the organic acid blend formulas was as effective as bacitracin methylene disalicylate in preventing feed conversion losses due to N.E (Figure 1). In addition, the two groups receiving the organic acid blends also had better weight gains than the challenged, non-medicated group and the group receiving bacitracin methylene disalicylate, (4.6%). A 4.2% improvement was seen over group 2 and a 4.6% improvement over group 3.

Figure 1. Adjusted FC and Body Weight Gain (28d)

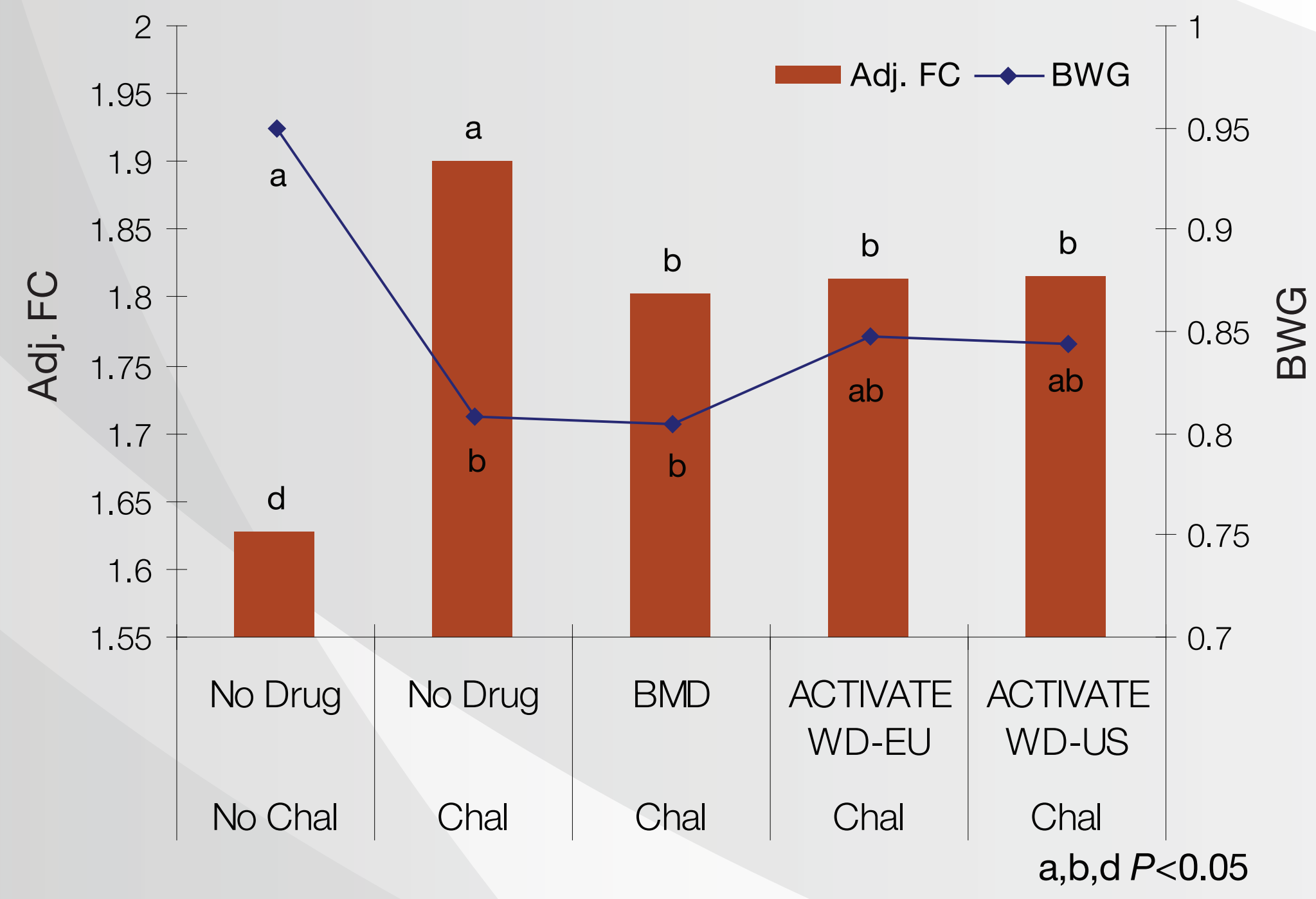

Figure 1: Feed conversion and body weight at 28 days. *Eimeria* challenge administered on day 14 (*E. acervulina*, 25,000 oocysts/ bird, *E. maxima,* 15,000 oocysts/bird) *Clostridium perfringens* challenge (10^8 CFU/bird) on days 18, 19 and 20.

N.E. gross lesions were mild in all of the challenged treatments (Figure 2). The three medicated treatment groups were not statistically different when compared to the challenged, non-medicated group. A numerical advantage, however, was observed in the birds receiving bacitracin methylene disalicylate. Similarly, there was no significant difference in mortality rate found among groups 2, 3, 4 and 5, although a numerical advantage existed for birds receiving bacitracin methylene disalicylate (Figure 3).

These trial data provide evidence that organic acids can be used in broilers to decrease the negative impact of N.E. on performance, and that they performed as effectively as bacitracin methylene disalicylate (BMD).

Figure 2. NE Lesion Scores (21d)

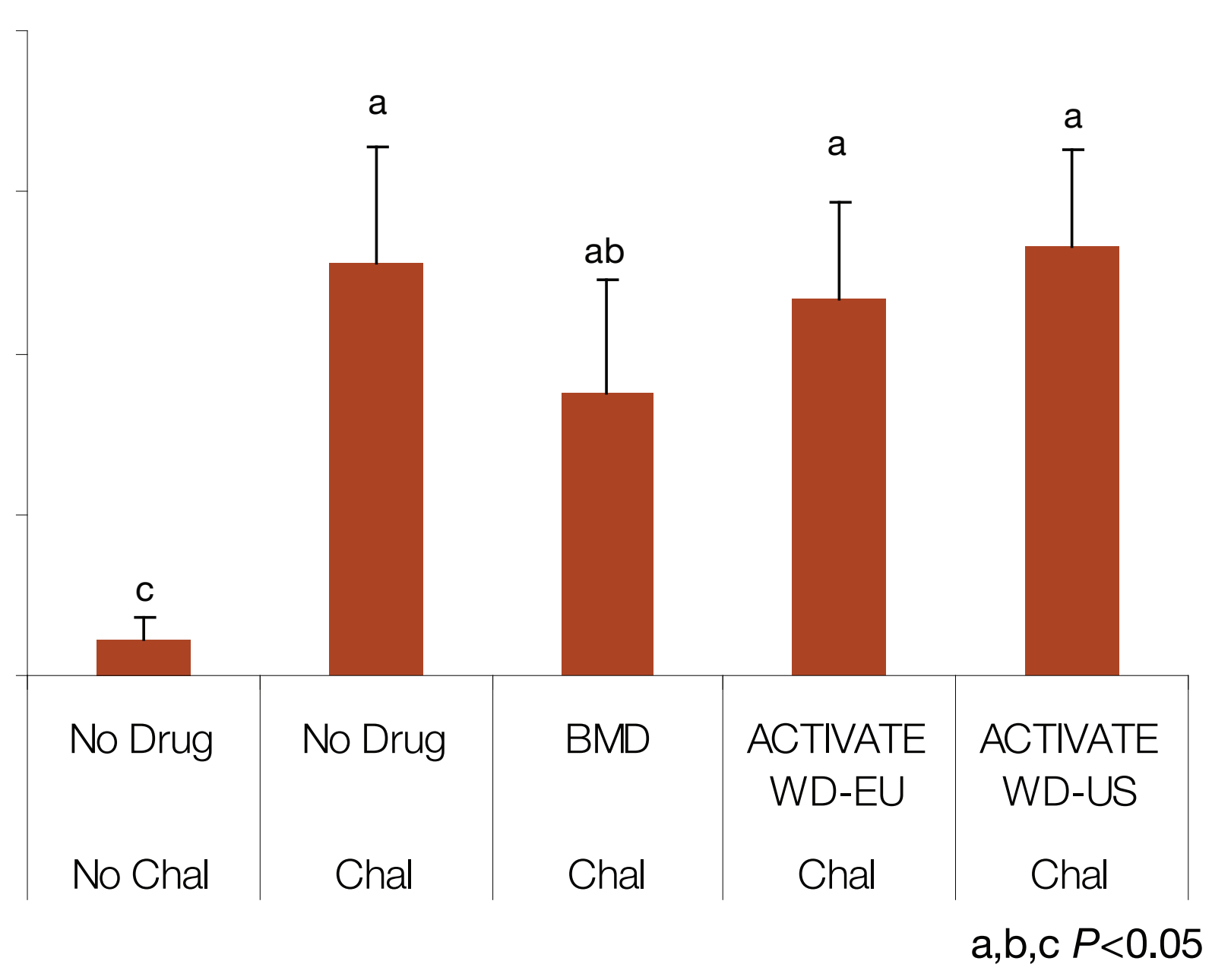

Figure 2: Necrotic enteritis lesion score (1) at 21 days. *Eimeria* challenge administered on day 14 (*E. acervulina,* 25,000 oocysts/ bird, *E. maxima,* 15,000 oocysts/bird) *Clostridium perfringens* challenge (10^8 CFU/bird) on days 18, 19 and 20.

Figure 3. Mortality due to NE (28d)

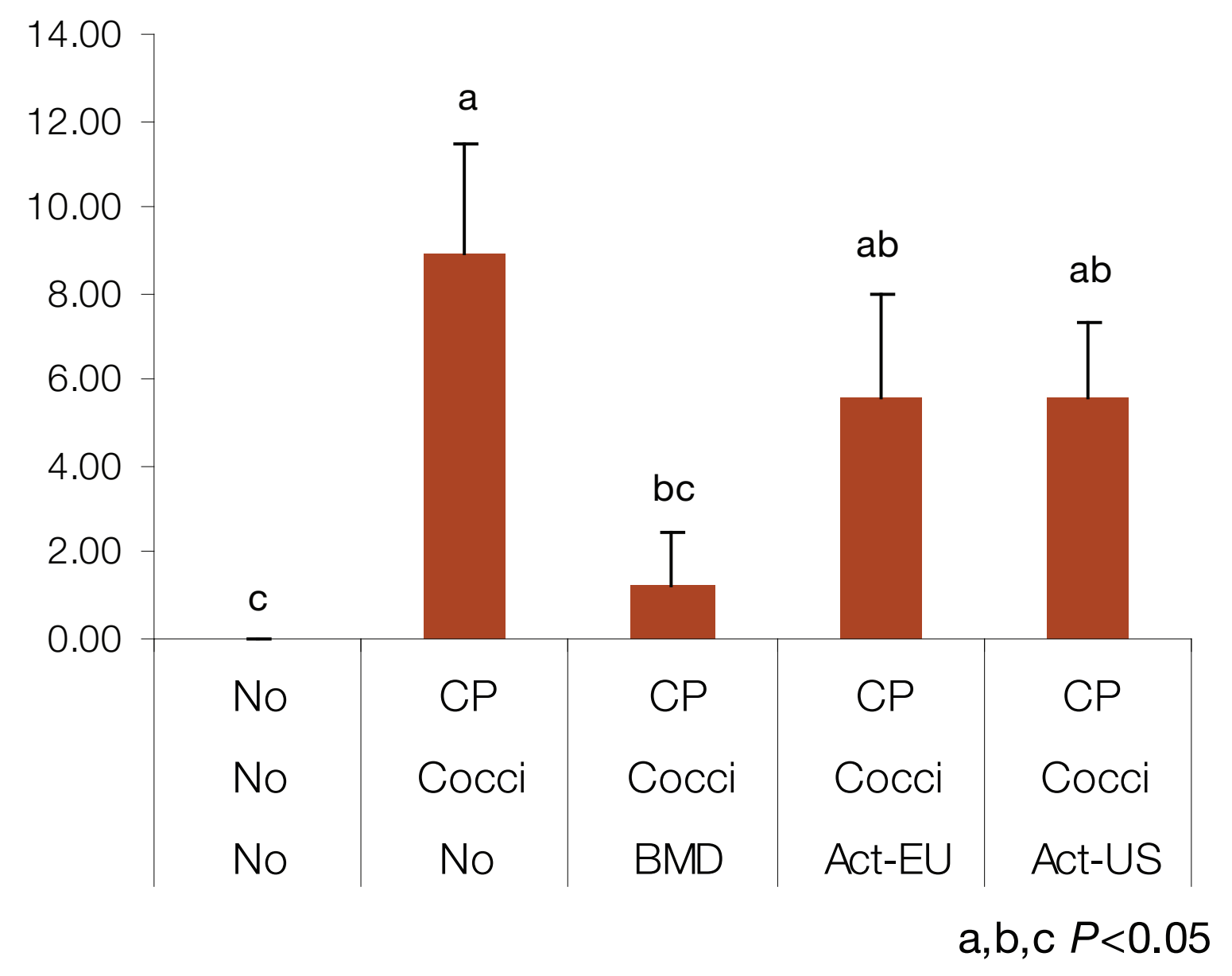

Figure 3: Necrotic enteritis mortaility (%) at 28 days. Eimeria challenge administered on day 14 (*E. acervulina*, 25,000 oocysts/ bird, *E. maxima*, 15,000 oocysts/bird) *Clostridium perfringens* challenge (10^8 CFU/bird) on days 18, 19 and 20.

SUMMARY

As long as we raise chickens, the poultry industry will continue to experience episodes of either clinical or subclinical necrotic enteritis. This means that we will always need methods of preventing *C. perfringens* infections even if we lose the ability to use growth promotant antibiotics. Understanding the multiple factors that can lead to N. E. will help utilize more natural methods, such as competitive exclusion cultures, organic acids, enzymes, probiotics and especially coccidiosis control.

This work shows that ACTIVATE organic acid blends can help establish a stable microbiota which can help reduce colonization of food borne pathogens (e.g. salmonella). Decreasing subclinical enteritis can help mitigate the negative impact of clostridium related diseases. However, it must be understood that the causes of these disorders are multifactorial in origin and that there is no single treatment that will overcome them completely. In particular, care must be taken to limit mucous production in the small intestine and prevent overgrowth of *Clostridium* resulting from the availability of nutrients in the small intestine associated with poor protein digestibility. Supplemental enzymes and other feed additives like organic acids can improve the stability of microflora communities and reduce the likelihood of small intestine bacterial overgrowth. Additional care must be taken to promote complete protein digestion to limit the amount of nutrients reaching the hindgut as this can result in more rapid growth of clostridium species and the potential for transfer of rapidly dividing of these opportunistic pathogens from the hindgut to the upper gastrointestinal tract. In all cases, care must be taken to address a wide variety of issues related to environmental contamination, gastrointestinal health as well as limiting oral exposure of the bacterial agents to provide a consistent high level of control for these pathogens.

REFERENCES CITED

1. Hofacre, C.L., T. Beacorn, S. Collett and G. Mathis. 2003. Using competitive exclusion, mannan-oligosaccharide and other intestinal products to control necrotic enteritis. *J. Appl. Poult. Res.* 12: 60-64.